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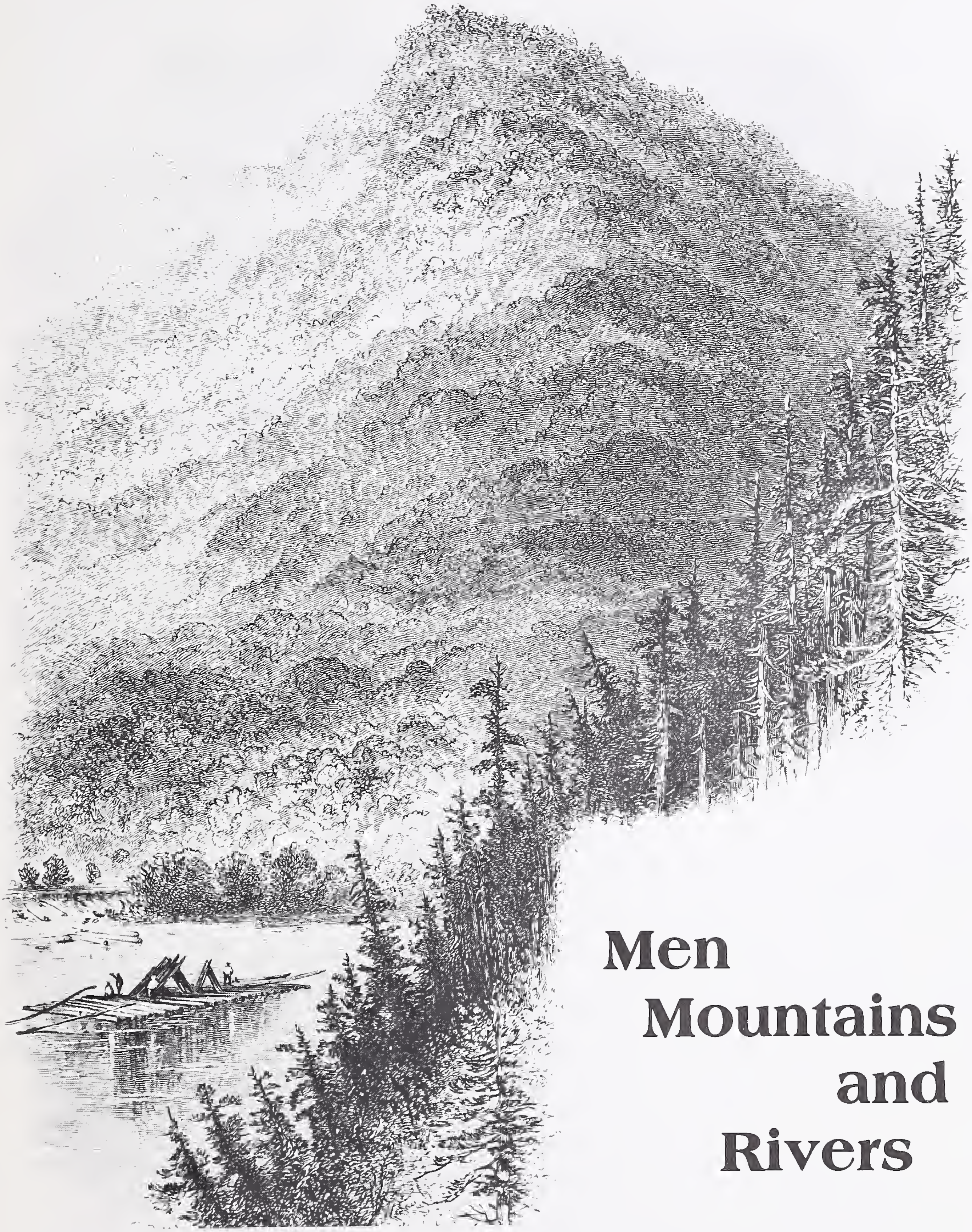

Men Mountains and Rivers

AN ILLUSTRATED HISTORY
OF THE
HUNTINGTON DISTRICT

U. S. ARMY CORPS OF ENGINEERS

1754 — 1974

By

Leland R. Johnson, Ph. D.

September 1977

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THE AUTHOR

Leland R. Johnson, an historian with degrees from Murray State, St. Louis, and Vanderbilt universities, is an avid whitewater canoeist and river history buff. He has written histories of several Engineer Districts including Nashville, Louisville & Pittsburgh, published many articles in scholarly and technical journals, and has twice been awarded the Toulmin Medal by the Society of American Military Engineers.

AUTHORS PREFACE

Some wag once quipped that an engineer is a person who shoots the bull, passes the buck, and makes three copies of everything. Fortunately for historians, engineers do make three copies of everything, and one eventually lands in the National Archives. Special appreciation must be expressed to Jesse A. Remington and Lenore Fine of the Engineer Historical Division who served as guides during my exploration of the uncharted mass of Record Group 77. Invaluable archival assistance was also supplied by the staffs of the Old Military Records Branch, National Archives, the Washington National Records Center at Suitland, Maryland, the Federal Regional Records Centers at Philadelphia and Kansas City, and the Library of Congress.

Thanks must also be extended to those efficient librarians who arranged entry into research sources at the Virginia State Library, Richmond; the West Virginia State Library, Charleston; the Kentucky State Library, Frankfort; the Ohio State Library, Columbus; the Inland Rivers Library, Cincinnati; the Joint Universities Library, Nashville; and the Tennessee State Library, Nashville.

The personal attention devoted by Gerald W. Sutphin and Clarence W. Newman, and John Chapman of the Huntington Engineer District to resolving the graphic and editorial enormities of this volume contributed substantially to any merit it may possess.

Finally, heartfelt gratitude is due to the men and women of the Huntington Engineer District whose cooperation allowed some insight into the turbulent human elements of the District history, thereby preventing this study from becoming a mere statistical and dimensional recitation. (Time and space limitations prevented personal mention of all men and women who have devoted their lives to the work of the Huntington Engineer District, for their names alone would form a second volume.) This volume is a tribute to the collective record they have made, but responsibility for any errors of fact or of interpretation belongs to the author alone.

Because this is the first effort to outline better than two centuries of Engineer history within the general boundaries of the modern Huntington Engineer District, it cannot pretend to be comprehensive and, in fact, does little more than develop a skeletal framework. Separate studies could and should be made of individual Engineer missions and projects, and this volume will be successful only to the extent that it provides a foundation for further study of the impact of Engineer activities upon the development of the Ohio River basin.

Leland R. Johnson
July 4, 1977

APPRECIATION

The Huntington District Historical Committee, speaking for all employees of the district, hereby expresses its utmost appreciation to the central figure in the development of this history—Dr. Leland R. Johnson.

In his quest for source material, often in dark and dusty corners, Dr. Johnson often exhibited his talent for uncovering the human side of past events. This touch of additional color is a principal factor in making this a highly readable history.

"Men, Mountains and Rivers" is another step forward in Dr. Johnson's career as an estabished historian.

Photographs not specifically credited in the captions are from District Files; drawing is by Mr. Bill Dawson.

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Chapter I

Engineers and Pioneer Navigation on the Ohio River

With oars flashing in and out of the blue Ohio, a fleet of seventeen bateaux and canoes carrying officers in British scarlet-and-blue regimentals, brightly painted warriors, roughly dressed frontiersmen, and sun-bronzed boatmen set out from Fort Pitt in June 1766 to the sound of cannon salutes reverberating from the hills.

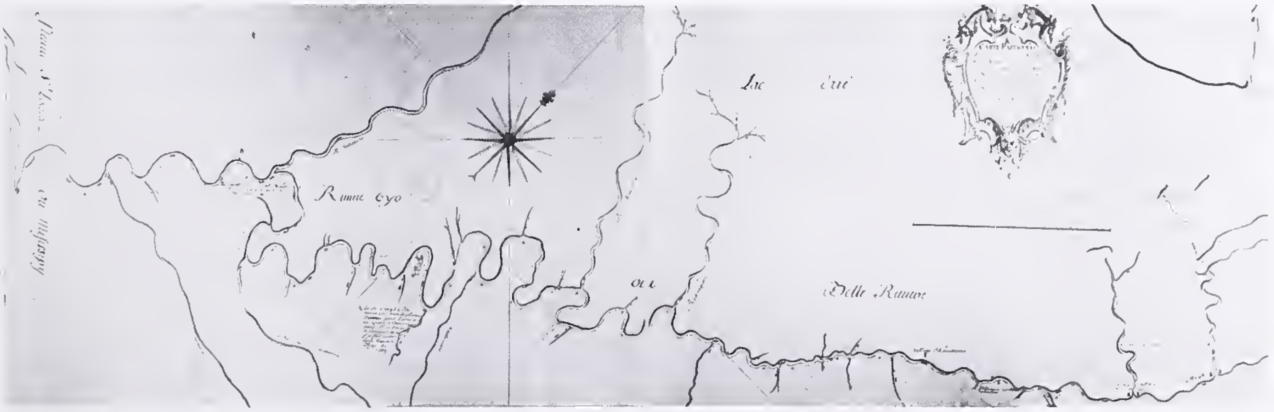
At long last the series of bloody colonial wars, culminating with the titanic struggle for empire known in America as the French and Indian War (1754-63), had ended in victory for the Anglo-Americans over the French and their Indian allies. The flotilla descending the Ohio River in 1766, bearing the torch of Anglo-American civilization, marked the final episode of the conflict between the French and British for empire in the interior of America.

British efforts to seize the strategic Ohio valley region had begun in 1753, when George Washington, a twenty-year-old major of the Virginia militia, carried a message from the governor of the Virginia colony to the French military commander beyond the Alleghenies demanding that the French evacuate the region. The French rejected this demand. After reporting this rebuff to the governor, Washington led a small force of Virginians across the mountains, only to be repulsed by the French. He returned in 1755 with the ill-starred British army commanded by General Edward Braddock.

When General John Forbes finally captured the French fort at the head of the Ohio for the British Crown in 1758, he thought he had gained control of the Ohio River basin, and wrote this jubilant dispatch:

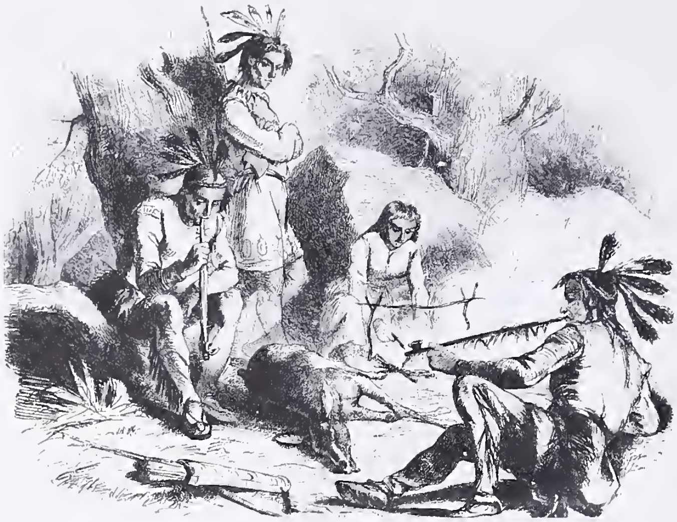
> Blessed be God, the long look'd for Day is arrived, that has now fixed us on the Banks of the *Ohio*, with great Propriety called *La Belle Riviere*, in the quiet and peaceable Possession of the finest and most fertile Country of *America*, lying in the happiest Climate in the Universe. This valuable Acquisition lays open to all his Majesty's Subjects a Vein of Treasure, which, if rightly managed, may prove richer than the Mines of Mexico . . . .

General Forbes was, however, overly optimistic, for continued Indian resistance under Chief Pontiac and other chieftains and limited knowledge of terrain and water courses blocked British attempts to gain full possession of the rich Ohio basin. Time and again, British troops seeking to occupy French posts in the Mississippi valley, by ascending the Mississippi River or by crossing from the Great Lakes basins failed, and not until



—*Library of Congress*

Early Map of Ohio River—by de Lery, 1740



The Aborigines, Natives of the Ohio River Valley.

—Eighty Year's Progress in the United States

1765, two years after the treaty of peace was signed, were all French posts in the Ohio valley surrendered to the British.

Even so, some means of supplying and reinforcing the isolated posts on the frontier had to be devised if the British presence in the valley were to be maintained. The British command naturally looked to the waterways as the easiest, most dependable routes through a vast forested area to the frontier garrisons. In 1766, a motley collection of frontiersmen, merchants, Indian warriors, and Army Engineers were ordered to descend the Ohio River to the frontier, to determine the navigability of the stream, to prepare accurate maps, to secure peace with hostile tribes, and to establish a dependable logistic line. As they were to be throughout the history of the Great American West, Army Engineers were in the vanguard of civilization in the Ohio valley.

During the hottest part of the summer of 1766, bronze-muscled warriors slashed paddles through the water and drove canoes and dugouts down the Ohio. American boatmen strained at the oars of their heavy bateaux burdened with Indian trading goods and military supplies, while British Army Engineers skimmed back and forth across the river in a light bateau, sounding its depth, finding the best channels, estimating the speed of the current, mapping the channel, the islands, and the banks, and seeking out campsites reasonably secure from Indian attack.

Leaders of British Ohio River Expedition

George Morgan, George Croghan, Harry Gordon, and Thomas Hutchins commanded the fleet during its descent of the Ohio in the sweating season of 1766, and no more colorful collection of characters ever navigated La Belle Riviere.

George Morgan, junior partner of a Philadelphia mercantile firm, had directed construction of bateaux for the expedition, and he accompanied the fleet in charge of the firm's trading and supply goods to determine the value of the Ohio as a trading route. He spent much time in the Army Engineer bateau to learn the intricacies of the river channel and also rigged a cabin in the stern of a bateau where, when violent summer storms forced the flotilla to the bank, he made computations of the number of men and boats which could be used in the river trade.

George Croghan, famed Indian agent who had helped George Washington carry General Braddock from the field of defeat in 1755, had command of the Indians with the expedition and was responsible for arranging peace with hostile tribes.

Captain Gordon and Lieutenant Hutchins were the Engineers ordered to map the Ohio and secure other intelligence useful to the British command. Both men were veterans of the French and Indian War and both were much interested in the resources and possible settlement of the Ohio Valley.

The relationships between these four frontier explorers suggested the multiple military and civil purposes of the expedition. Thomas Hutchins had served as assistant to Indian Agent George Croghan before accepting a commission in His Majesty's 60th "Royal American" Regiment. He and George Morgan became fast friends during 1766 and later cooperated in planning new settlements on the frontier. Captain Gordon and George Croghan had served together during the Braddock expedition of 1755 and were partners in land speculation. Croghan was also a silent partner in the firm represented by George Morgan. Croghan was to conciliate Indian tribes with gifts and brought a hundred friendly warriors to defend the expedition if necessary. Morgan brought supplies for British garrisons and goods for opening an Indian trade. Engineers Gordon and Hutchins were to map the Ohio River for future military and supply expeditions, and their maps would also serve as a guide for early commercial navigation needs.

Moving only during daylight hours on unknown channels littered with unseen obstructions, the British fleet, averaged forty miles a day, although frequently delayed by boats grounding on river bars. When the bateaux rammed and stuck on a gravel bar, they were pried free in a simple fashion—the boatmen clambered over the side into the water and pushed—but at least one man was drowned when he lost his footing and was swept into deep water.

The Engineers thought the Ohio River remarkably useful for transport, certainly when compared with primitive overland trails. Captain Gordon was impressed by the "noble" and enchanting scenery along the Ohio between the mouths of the Muskingum and the Scioto rivers with stately timber-covered islands, long stretches of easy navigation, and banks lined with "finest trees of various verdures."

After a pause at the mouth of the Scioto, George Croghan conferred with Indian chieftains while other members of the expedition hunted buffalo. The flotilla continued downriver, reaching the mouth of the Ohio on August 7 and turning up the Mississippi to British posts in Illinois. Gordon, Hutchins, and Croghan returned to the east via the Mississippi River and sailing ship to report to the commander of British forces in America.

The Hutchins-Gordon report was the first detailed hydrographic-topographic survey of the Ohio River. It provided reliable information about river navigation, intelligence about the strength of Indian, French, and Spanish forces and fortifications, accurate appraisals of transportation routes, and descriptions of likely sites for camps and fortifications—precisely the type information necessary for proper policymaking and troop disposition and logistics planning. Copies of the Hutchins-Gordon report and maps were furnished to British units ordered to the frontiers and Thomas Hutchins was ordered back to the Ohio Valley in 1768 to serve as guide and to construct an armed bateau for river patrol.

George Morgan constructed sixty-five flatbottomed bateaux at Pittsburgh (Fort Pitt), 1765-67, and employed 315 boatmen for the Ohio River trade. He was able in one year alone to move merchandise valued at *L* 55,000 up and down the Ohio. In the bateaux, which resembled large skiffs or "jonboats"—manned by four rowers and a coxswain for downriver trips, eight rowers against the current—Morgan inaugurated commercial navigation on the Ohio River years before western Virginia, Kentucky, and Ohio were settled and before such ports as Marietta, Gallipolis, Cincinnati, Parkersburg, Point Pleasant, Guyandotte, Maysville, and Louisville were founded. The expense of transporting small cargoes in bateaux proved heavy and the Indian trade less lucrative than hoped, and the bateau trade was nearly abandoned with the onset of the American Revolution in 1775. However, Morgan built several armed bateaux for use of the American forces navigating the Ohio during the Revolution, and the use of bateaux for commercial navigation continued on some Ohio River tributaries until supplanted by the developing railroad network, and connecting local roads, late in the nineteenth century.

Thomas Hutchins, after service with the "Royal American" Regiment in the lower Ohio valley and supervision of fortification construction at Pensacola, Florida, was promoted to the rank of captain. At the beginning of the American Revolution, he was in London preparing his maps and topographic description of the Ohio valley for publication, but was clapped in irons on charges of treason because he corresponded with Samuel Wharton, a partner of George Morgan and a secret American agent. His correspondence concerned business matters and British authorities could find no evidence of treason, but Hutchins, on his release from prison, fled London to France, took the oath of allegiance to the United States before Benjamin Franklin, returned to the United States as secretary to John Paul Jones, and, with recommendation from Franklin, joined the Corps of Engineers, United States Army. At the close of the Revolution, Congress appointed Hutchins "Geographer to the United States," equivalent to Chief of Topographical Engineers, and he returned to the Ohio valley to begin surveys of the territory northwest of the Ohio River in preparation for its sale and settlement. His maps of the Ohio basin, published in London in 1778, were the best available for many years. Copies were supplied American troops in the valley and were carried by many of the pioneers searching for new homes on the frontier.

Role of the Ohio in the Western Settlement

The American Corps of Engineers, established by Congress on June 16, 1775, was first commanded by Colonel Richard Gridley and Colonel Rufus Putnam, who, like Hutchins, gained their engineering experience in the British Army during the French and Indian War.

Putnam, second Chief Engineer of the Army, participated in a series of major battles of the Revolution, directed construction of fortifications at West Point, and by the end of the war had

1938 Reenactment of Pioneers Landing at Marietta, Ohio, in 1788.

risen to the rank of Brigadier General. When the Army demobilized at the end of the Revolution, General Putnam, who had long been interested in settlement on the frontier, became a deputy surveyor of the Northwest Territory with Thomas Hutchins and organized the Ohio Company to secure land grants in the Northwest for veterans of the Revolution. At the advice of Hutchins, Putnam and his associates in the Ohio Company selected lands for settlement along the Ohio and Muskingum rivers and dispatched experienced New England shipbuilders to the Youghiogheny River, a tributary of the Monogahela, to construct boats suitable for navigating the Ohio. In flatboats and the armed galley *Mayflower*, General Putnam led a band of pioneers down the Ohio in early 1788 and founded the settlement at the mouth of the Muskingum River which became Marietta, Ohio.

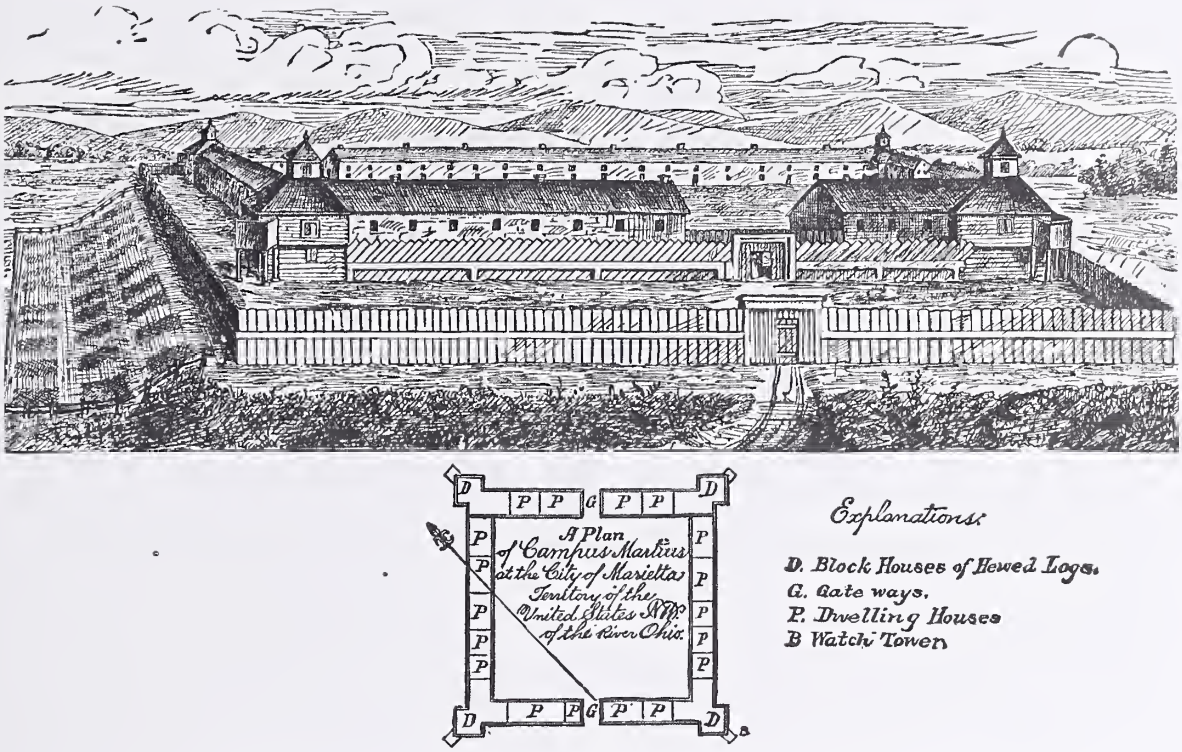
Use of the Ohio River by General Putnam and his Ohio Company associates as an avenue for immigration was not unique. A swelling tide of immigrants flooded down the Ohio after the Revolution.

The population of the Ohio River basin in 1775 was limited to settlements near Fort Pitt and a few scattered frontier posts; by 1790 the transmontane population had soared to 125,000 and the "Great Migration" was under way. In the spring of 1788, 308 boats, transporting 6,320 pioneers, 2,824 horses, 515 head of cattle, 600 sheep, 9 hogs, and 150 farm wagons glided past Fort Harmar (Marietta) at the mouth of the Muskingum.

During the waning years of the eighteenth century and the early years of the nineteenth, uncounted thousands of pioneers swarmed down the Ohio. Brownsville on the Monogahela, Olean on the Allegheny, Kelly's Station on the Kanawha, and Pittsburgh and Wheeling on the Ohio River became major ports of embarkation for Ohio valley pioneers.

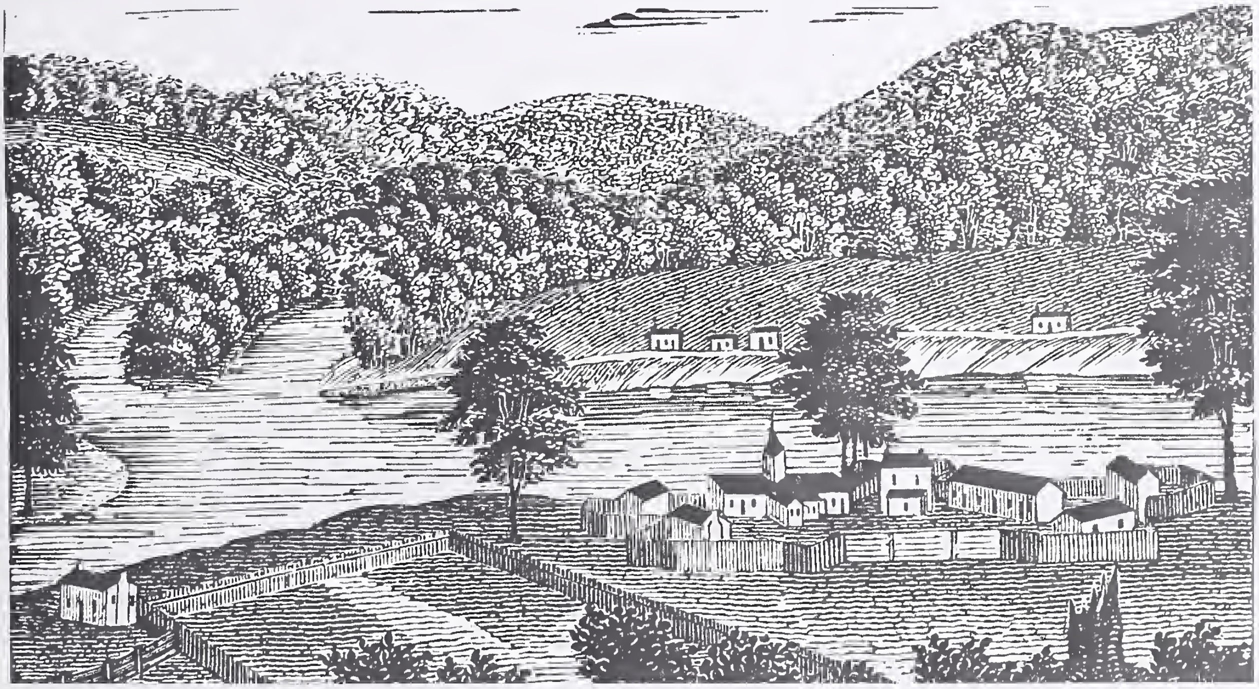
Ark of Empire

Watercraft of every conceivable sort were used


A Plan
of Campus Martius
at the City of Marietta
Territory of the
United States N.W.
of the River Ohio.
D
P
G
B
Explanations:
D. Block Houses of Hewed Logs.
G. Gate ways.
P. Dwelling Houses
B Watch Tower

—*Howe's Historical Collections of Ohio*

Campus Martius
A frontier fort built in 1789 for the protection of the settlement of Marietta against Indian raids.



—*Howe's Historical Collections of Ohio*

Fort Harmar
A frontier post located across Muskingum River from the site of Marietta, Ohio, in 1788.

by Ohio River immigrants, but most traveled in the family flatboat, aptly called the "ark of empire," whose size varied according to the skills, needs, and funds of each family. A newspaperman interviewed passengers of a twelve-foot long flatboat as it passed the mouth of the Guyandotte River, finding an elderly couple aboard who had set out for the West because they became lonely after their children and neighbors had gone "out back." On the other hand, he also saw two eighty-foot flatboats lashed together, bearing small houses, a haystack with horses and cattle feeding, plows, wagons, pigs, poultry, and children, which, to a grunting, squalling, and neighing chorus, were delivering several pioneer families to new homes.

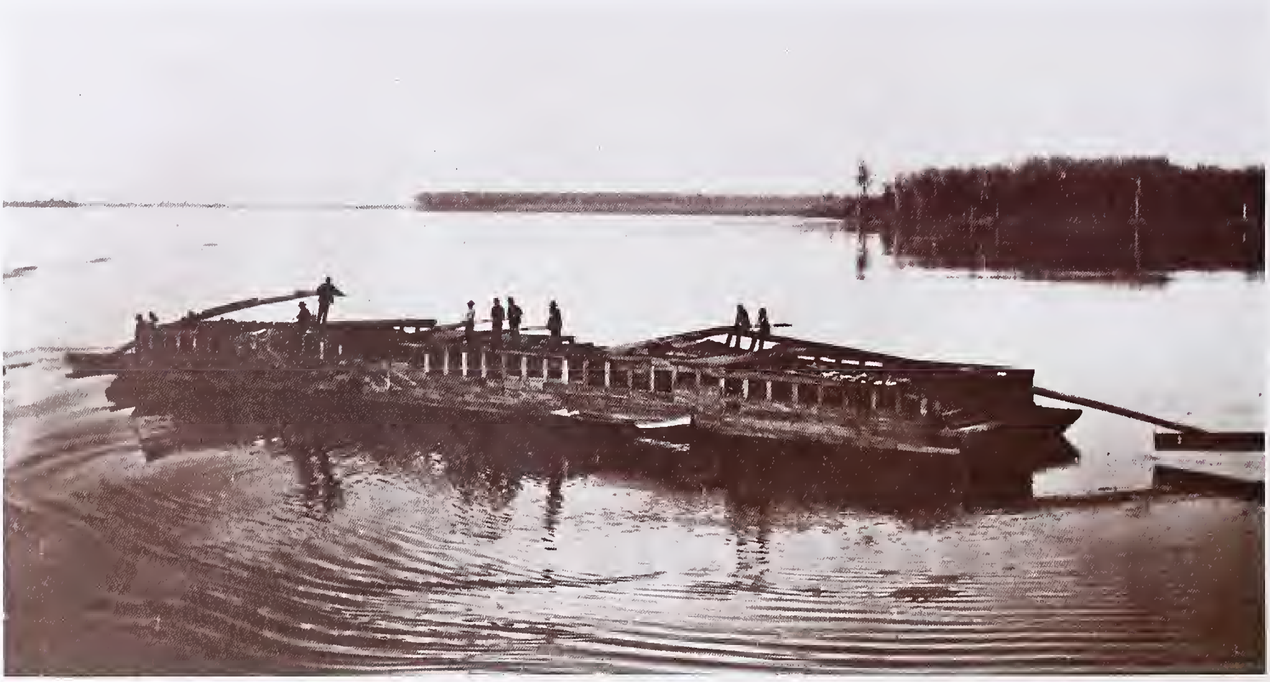
The flatboat, originally merely a sturdy, watertight wooden box, was used by immigrants because it was of simple construction and could be built with much greater capacity than Indian canoes and dugouts or the bateaux. With flat bottom and sides, half covered with a roof for shelter and half open for animals and wagons, family flatboats resembled "good, large well covered hog-sties." Each flatboat had long steering oars at the sides and stern, used, one contemporary explained, "only to direct the course of the flat, which is allowed to float with the current, and thus she pursues her voyage, like man on his earthly pilgrimage, to that undiscovered country from whose bourne no traveler of her species ever returns; for, not being calculated to stem the current, she is useless after she has reached her destination, except as so much lumber."

Travel Hazards of the Natural River

Though travel was much easier by river than by overland routes, great hazards attended navigation on the unimproved waterways. During the earliest period of immigration there was danger of Indian attack, and always there was risk of wrecking on rocky rapids, grounding on bars, or ramming submerged and unseen snags.

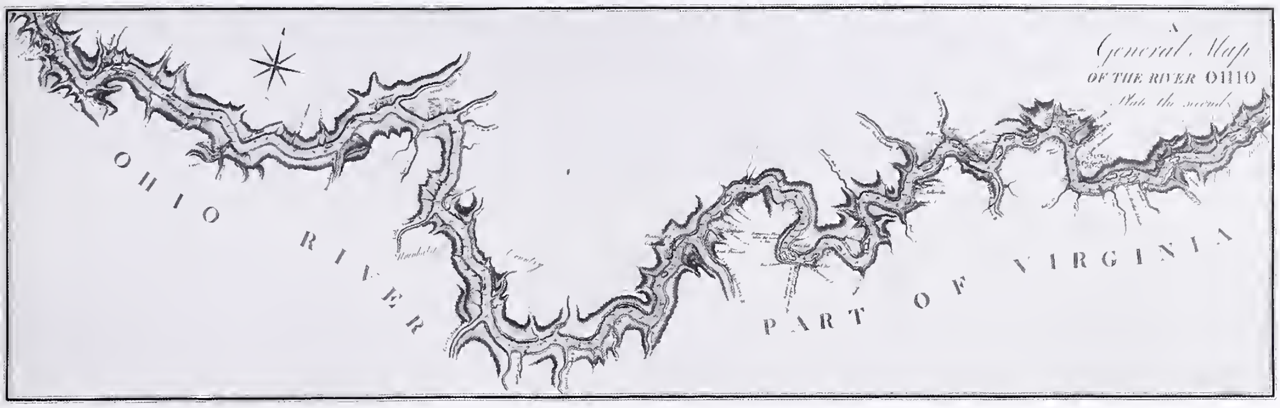
Timothy Flint, who descended the Ohio in a flatboat in 1815, said the boat sometimes jostled on rocks in the ripples, sometimes drove furiously down the chutes, and sometimes stuck fast on sandbars, and when the boat hit the rapids and bounced from one rock to another, the adults paled, the children shrieked, and supplies cascaded from shelves onto the navigators. Flint eventually abandoned his flatboat for a skiff, which would not go aground so frequently on bars.

Navigational hazards in the 981-mile course of the unimproved Ohio River arose chiefly from its snag and boulder-strewn condition and the fact that its slope, about 429.4 feet from the head of



—*Library of Congress*

Flatboat on the Mississippi River, typical of those used in the early days of river transportation from Pittsburgh to New Orleans.



—"A Journey in North America; Atlas"
Victor Collot–1826

A General Map of the Ohio River

the river to its mouth, was not uniformly distributed; dangerous rapids such as Letart Falls, where gradient was steep and current swift, alternated with quiet, deep pools with negligible slope. Fluctuations between low and high water stages were also extreme and unpredictable, ranging from as little as a foot deep during extended droughts and up to eighty feet at floodtimes. From a mere trickle of 1,100 cubic feet per second (cfs) near the head of the river, the Ohio could surge to a devastating floodflow of 200,000 cfs near its mouth.

Revealing accounts of the difficulties of navigation on the Ohio during the pioneer era were written by Major Andrew Ellicott, an early Army Engineer, in 1796, and Captain Meriwether Lewis, leader of the Lewis and Clark Expedition, in 1803.

Andrew Ellicott, noted scientist and astronomer, succeeded Thomas Hutchins as "Geographer to the United States" in 1789, and in 1796 he boated down the Ohio and Mississippi rivers to survey the southern boundary of the United States. When Ellicott and his party set out down the Ohio on October 23, 1796, the usual fall rise had not occurred, the river was shallow, and many shoals impeded navigation. By the time they reached Marietta the boats had been heavily damaged, and Ellicott reported his men "much fatigued by dragging our boats over the shoals." Just below Gallipolis on November 15, one of Ellicott's boats wrecked and was lost and the remainder grounded on bars. Ellicott said navigating the Ohio River was one of the most "miserable" experiences of his life; he discovered when he reached Cincinnati on November 25 that his boats were the first to arrive there since the previous August.

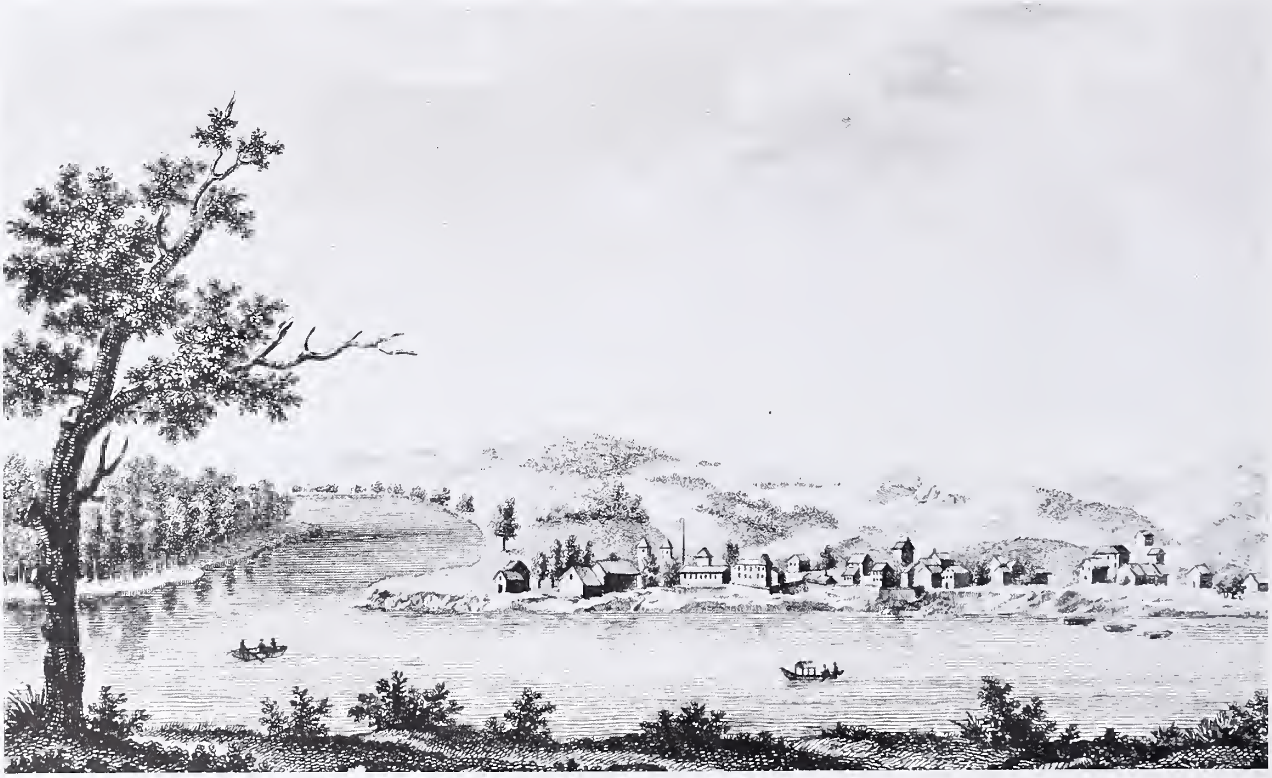
Captain Meriwether Lewis had an even worse experience with Ohio River navigation in 1803 when he descended the river in a pirogue laden with Indian trading goods on the way to the Pacific Ocean. Troubles began on September 1 at McKee's Rock, a few miles below the head of the Ohio, where the crew of seven soldiers, three civilians, and a pilot had to jump out of the boat, pick it up, and drag it over a shoal. This process was repeated at every shoal on the upper river, and as his men became exhausted Captain Lewis hired horses and oxen to tow the boat downriver. Below Steubenville, Ohio, Captain Lewis thought clear sailing appeared possible and raised a mast, unfurled a sail, and skimmed off downstream, only to ram a shoal, break the mast, rip the sail, and again resort to oxen, which, Captain Lewis told President Thomas Jefferson, were the "most efficient sailors" on the river.

At Sistersville, Virginia, Captain Lewis and his men cut channels for their boats through gravel bars with spades and canoe paddles by stirring the gravel for the current to wash downstream. Lewis informed President Jefferson it was possible to cut a fifty-yard-long passage for the boat in this fashion in only an hour! By the time Lewis reached Marietta, his men were demoralized and the civilians resigned, but below Marietta the party made better time, passing the mouth of the Little Kanawha and Big and Little Hocking rivers to camp near Belleville, Virginia, on September 15. After some difficulty in passing the rapids at Letart Falls, a stop to dry water-soaked cargo near Portsmouth, Ohio, and a rest stop at Cincinnati, Captain Lewis finally reached the mouth of the Ohio River on November 15. Two and a half months to navigate the Ohio, and downriver at that, but doubtless superb training for the hardships members of the Lewis and Clark expedition were to endure during their journey to the Pacific.

Experiences of Williams and Macomb

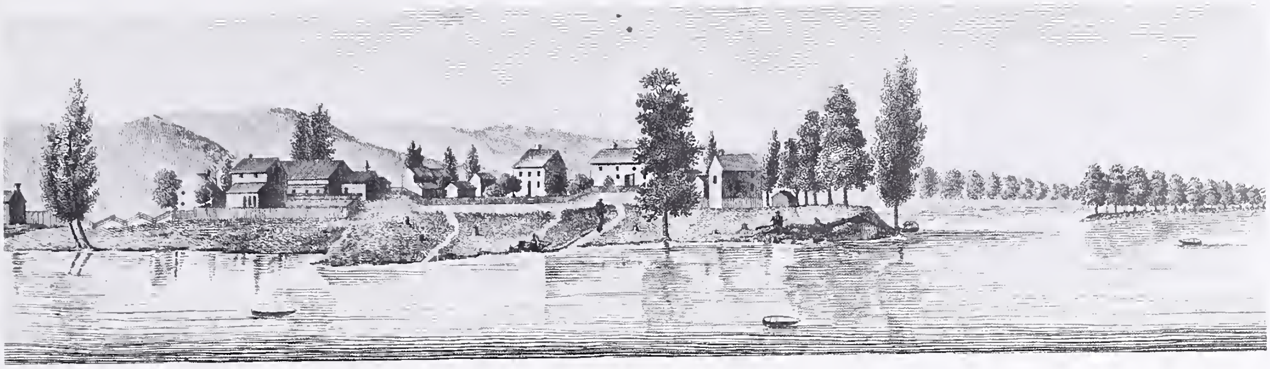
Despite all hazards, travel by waterways was much easier than by primitive trails and roads, and this fact was marked by Major Jonathan Williams, who had a pleasant flatboat trip down the Ohio in 1801. Williams, assisted by Lieutenant Alexander Macomb—both men later served as Chief Engineer of the Army and they jointly designed the distinctive "Essayons" button worn by Engineer officers—departed Pittsburgh in July 1801 on the way to Cantonment Wilkinsonville near the mouth of the river to conduct maneuvers and ordnance experiments with the Second Regiment of Artillerists and Engineers. Horses, troops, and the U.S. Army Band crowded aboard three large flatboats, which Williams described as like "floating houses," and, because the river was at a prime boating stage, floated swiftly downstream, stopping only at Maysville, Kentucky, to purchase more horses.

Except at rapids, Major Williams found navigation excellent, and serenades played by the flutes, violins, and clarinets of the Army band did much to relieve the tedium of the journey. Williams was impressed by the neat homes and well-cultivated lands he saw near such ports as Marietta, and was startled by the size of families along the river, estimating that each couple had six children. Why, with such production, in less than a century they may "defy the power of the world," he exclaimed! "The Ohio may in that time represent what the Rhine is now." For beauty of

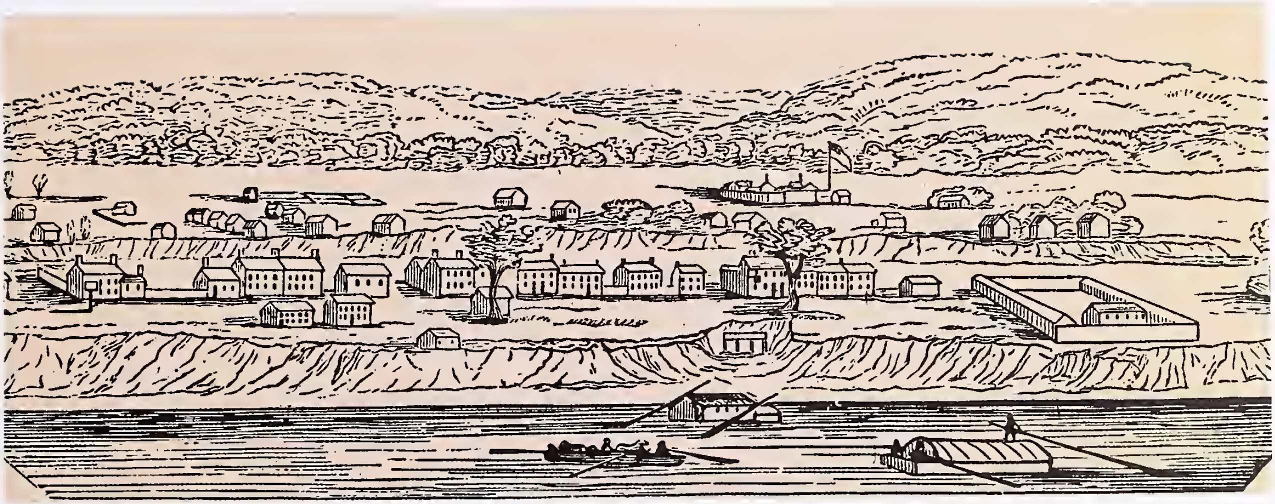


—*Library of Congress*

Early view of Pittsburgh
Williams and Macomb departed here in July 1801 on their expedition down the Ohio.



Marietta, Ohio.



Cincinnati, Ohio, 1802

—Howe's Historical Collections of Ohio

Two more of the historical cities involved in the pioneering and colonization of the Ohio and Mississippi Rivers.

scenery, fertility of soil, and navigable waterways, he thought the Ohio valley unsurpassed: "The French used to call this *la belle Riviere*–I believe it to be *la plus belle de l'universe.*" Jonathan Williams, a relative of Benjamin Franklin who served with Franklin in France during the Revolution, was appointed first Chief Engineer of the modern Corps of Engineers organization, established when President Jefferson signed a bill separating the Engineer from the Artillery service on March 16, 1802.

Colonel Williams may have gotten an entirely different opinion of Ohio River navigation when he poled his way back upriver in a canoe the following year to take up his new station.

River Trade with New Orleans

Barthelemi Tardiveau, a Frenchman who immigrated to America during the Revolution at the advice of Jonathan Williams, to supply George Rogers Clark and the American Army in the West, had shipped the first boats laden with valley produce to New Orleans in 1782, thus launching a trade which became vital to early Ohio valley economic development. Tardiveau lost his first shipment to "pirates," but he began a study of navigation and trading conditions in preparation for further ventures, sending questionnaires to several frontier leaders. Walker Daniel, first Attorney General for the Kentucky District, informed Tardiveau that boats for the New Orleans trade should be cheaply built and sold along with the cargo. Frontiersman John May, for whom Maysville, Kentucky, was named, told Tardiveau the pioneers were then producing commodities sufficient only for subsistence, but that, after troubles with the Indians ended, agricultural and commercial development would be unlimited. May did not survive to see this development—while piloting a flatboat from Kelly's Station on the Kanawha to Maysville in 1790, he was killed by Indians near the mouth of the Scioto River.

Tardiveau published the results of his navigation study in 1787, in which he asserted that Ohio valley prosperity was dependent upon use of the waterways as an outlet to markets. He engaged in several trading ventures along the Ohio River, became a close friend of Thomas Hutchins, and became interested in the plans of Hutchins and George Morgan to found a settlement in Missouri near the mouth of the Ohio. After the death of Hutchins in April 1789, Tardiveau continued the colonization plans and led some French families from Gallipolis, Ohio, to found a settlement at New Madrid, in Missouri.

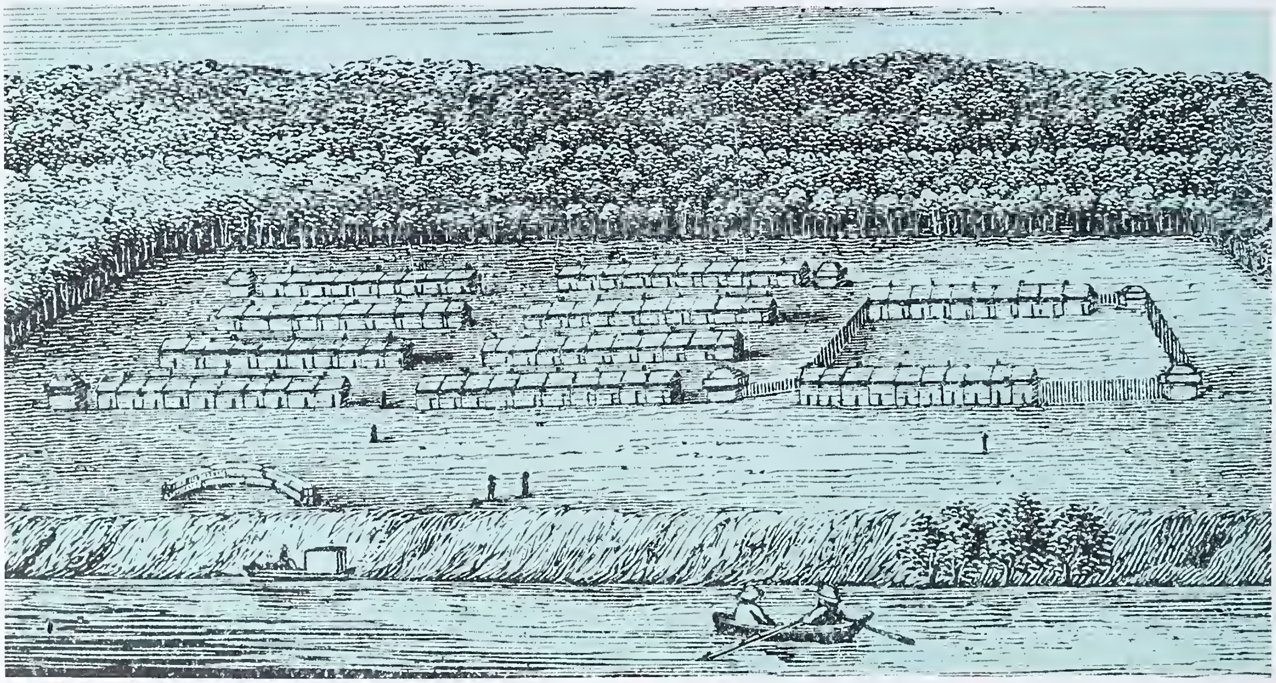
The commerce with New Orleans launched by Tardiveau in 1782 continued on a small scale throughout the late eighteenth century, but was limited by the capricious Spanish authorities who then held New Orleans.

Securing control of New Orleans as an outlet for the commerce of the Ohio valley and the West became a primary objective of American foreign policy and also of Ohio valley political leaders, who often threatened that the valley might leave the Union unless complete American control of the Ohio-Mississippi waterway were gained. This objective was achieved through purchase of the Louisiana Territory in 1803. Thereafter the trade between the Ohio valley and New Orleans burgeoned.

The New Orleans trade was conducted principally in the one-way flatboats that descended the Ohio and Mississippi by the thousands on every river rise during the early nineteenth century. On June 13, 1806, for example, 237 flatboats lay at the New Orleans wharf and glutted the market with Ohio valley commodities. From October 5, 1810, to May 5, 1811, about 1,200 flatboats descended the upper Ohio River on the way to the "Crescent City," burdened with 130,000 barrels of flour, over 600,000 pounds of bacon, 10,000 barrels of whiskey, and huge quantities of butter, pork, hemp, cheese, livestock, and other farm produce. In late 1821, 2,000 flatboats constructed in the upper Ohio valley, transporting at least 600,000 barrels of flour, were on the way to New Orleans or preparing to depart.

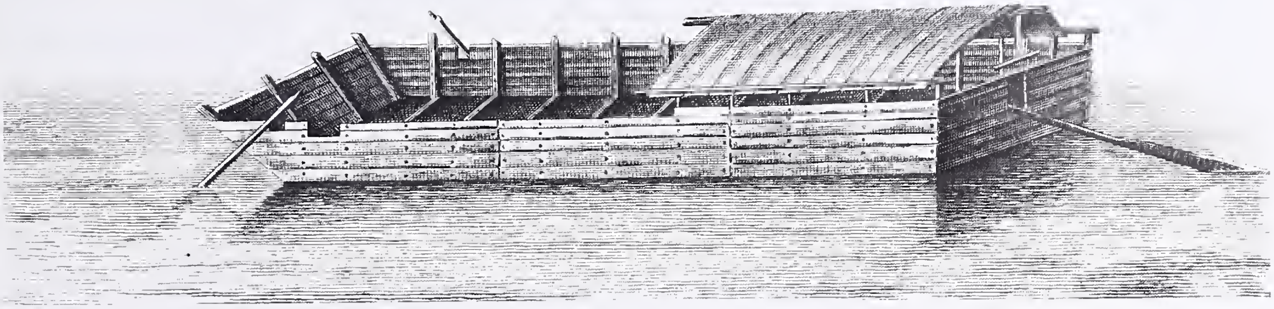
Growth of Ohio River flatboat commerce was not interrupted when steamboats began thrashing up and down river, did not begin to decline until after 1847 when railroads first began to offer competing transportation routes, and some flatboats were still plying the Ohio as late as 1900. Of all watercraft developed and used by Ohio valley pioneers, flatboats carried by far the greatest tonnage, greater even than that carried by steamboats before the Civil War.

The first flatboats built on the upper Ohio for the New Orleans trade were about forty feet long



—*Howe's Historical Collections of Ohio*

Gallipolis, City of the French, in 1790



—"*A Journey in North America; Atlas*"
Victor Collot–1826

Sketch of a flat bottom boat, typical of those used to descend the Ohio and Mississippi Rivers. Built on the upper rivers, they were called "one way" as they were sold—cargo, boat and all—in New Orleans.

and fourteen feet wide, their width limited by dangerous rocks about fifteen feet apart in Indiana Chute at the Falls of the Ohio. After the Corps of Engineers removed the rocks and other obstructions, and as boatbuilding skills improved, larger and more economical flatboats were built, some a hundred feet long and twenty wide, capable of carrying up to 350,000 pounds of cargo.

Though sturdily built, the wooden hulls of flatboats were frequently ripped open by rocks, pierced by snags lurking beneath the river surface, and bilged on shoals. Captain Henry Shreve of the Corps of Engineers estimated in 1827 that at least fifty flatboats went to the bottom of the river each year after ramming submerged snags in the channel—and these losses were experienced after the Corps had removed hundreds of the more dangerous snags.

In addition to dangers of navigation, Ohio River flatboatmen in the earliest days of the New Orleans trade ran the risks of robbery by gangs frequenting the lower Ohio River, and murder by bandits lurking along the Natchez Trace and other cross-country trails traversed by boatmen on their walk home from New Orleans. Captain William Tell Poussin, an Engineer officer who often descended the rivers by flatboat, said it took him sixty to seventy days to reach New Orleans from upper Ohio ports, and it was not "without exposure to difficulties and perils of no ordinary kind that so protracted a journey could be performed in the midst of the numerous Indians, who, allured by the hope of booty, at that time frequented the shores of these rivers."

Shipbuilding on the Ohio River

Flatboats and their cargoes were sold at New Orleans to merchants supplying Southern plantations or engaged in foreign trade. By 1800, however, it had occurred to several Ohio valley shippers that the middle man at New Orleans might be eliminated if vessels were constructed that could descend the inland rivers and enter foreign trade directly from Ohio River ports.

The idea that ships might be built along the Ohio and sent to sea freighted with Ohio valley produce was suggested as early as 1778 in the description of valley resources published by Thomas Hutchins; and in 1793 a ship built on the Monongahela River successfully made such a voyage. By 1800 a thriving shipbuilding industry was developing at several Ohio valley ports, notably at Pittsburgh and Marietta.

Several experienced New England shipbuilders immigrated to Marietta with General Rufus Putnam in 1788, and their experience gave Marietta an edge in the Ohio River shipping industry. More ships were built there than at any other Ohio River port. The *St. Clair*, the first ship built at Marietta, cleared the port in May 1801 with a cargo of pork and flour. Under command of Commodore Abraham Whipple, distinguished veteran of the Continental Navy, it arrived at New Orleans in July 1801 and sailed thence to Havana, where the first cargo was sold and another of sugar purchased for delivery to Philadelphia. Between 1800 and 1808, the Marietta shipbuilders completed about twenty-five ships for coastal and international commerce.

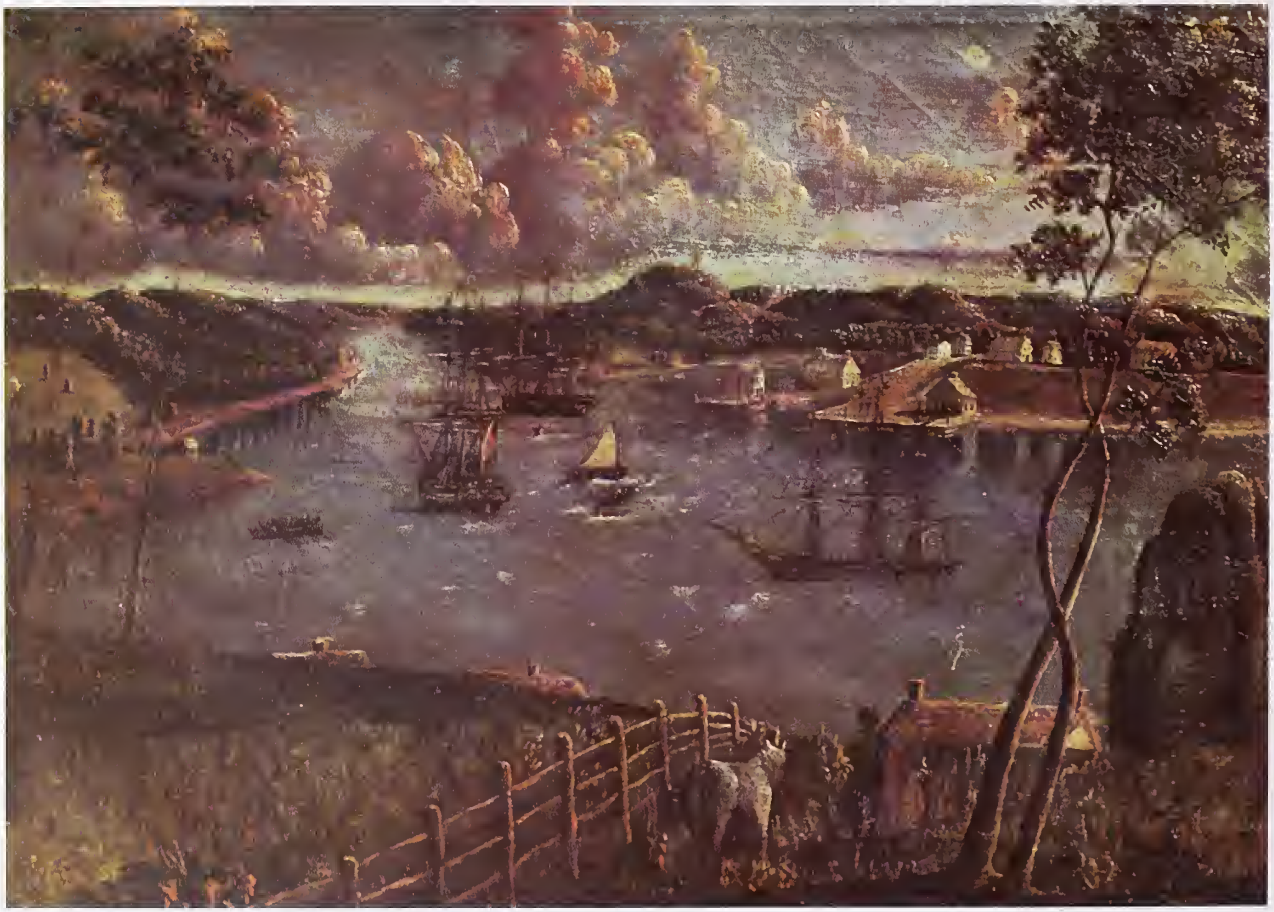
Merchant-shippers Benjamin I. Gilman and Edward W. Tupper dominated the Marietta shipping industry. Gilman, owner of the largest store in Marietta and trading stations on the Big Sandy and Guyandotte rivers, where furs and ginseng were purchased for export, employed master carpenters Jonathan Devol and James Whitney to build his ships.

The typical Marietta ship resembled the 350-ton *Frances*, built by James Whitney in 1807, which had two decks, three masts, and a draft of eleven feet, and was 99.5 feet long and 28.5 feet wide. Tupper employed Joseph Barker, who also built bateaux for Aaron Burr and a ship for Harman Blennerhassett, as master shipcarpenter, and sent many ships down the Ohio to foreign ports. One of the Tupper boats, the *Louisiana*, gained special fame when it left Marietta in 1803 and, via Norfolk, Va. and Liverpool, arrived at Trieste, Italy, in the Mediterranean, where its captain had trouble convincing authorities that a seaport named Marietta existed.

Ohio River ships commonly went downriver under command of experienced sea captains, who sailed them to Atlantic ports, from whence they entered transoceanic commerce. Because the Ohio was too narrow in most places for sailing and tacking, Ohio River brigs, schooners, and ships, like flatboats, never returned to their home ports.

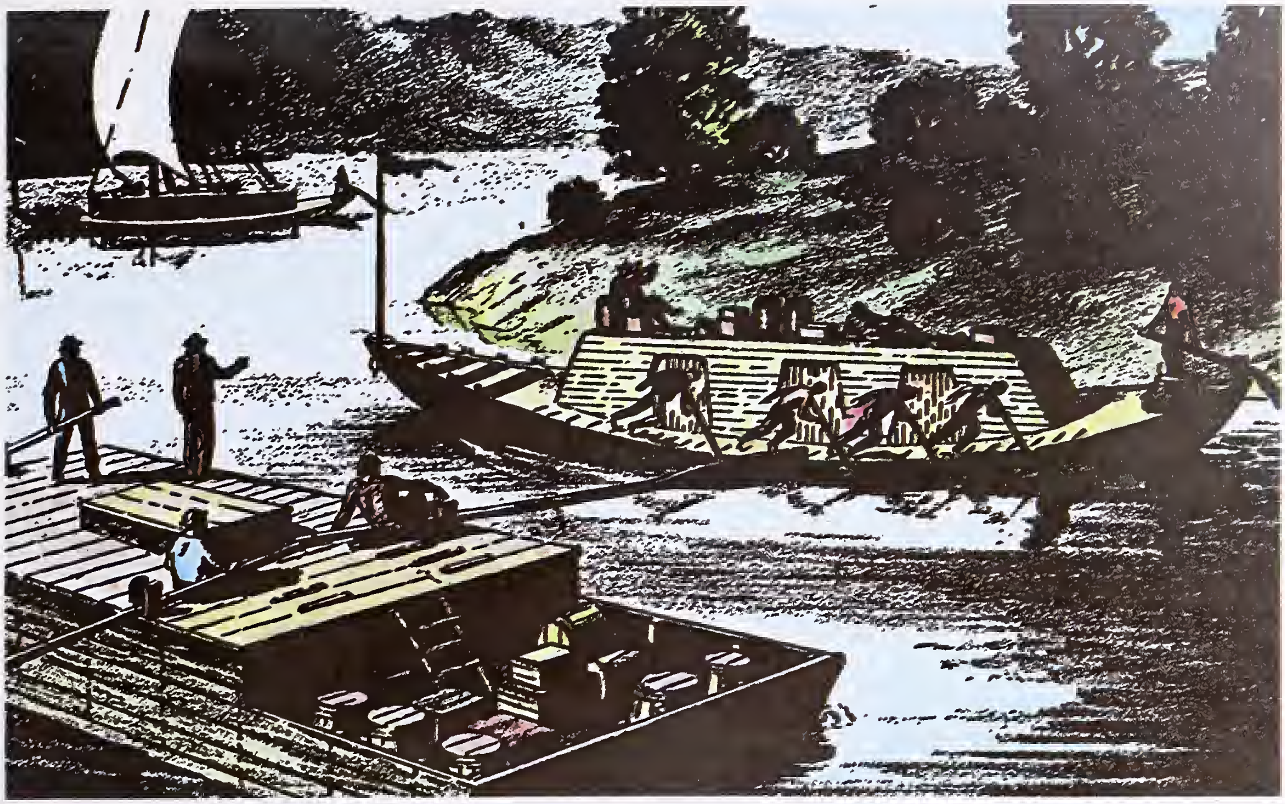
Many ships were actually built under contract with merchants of New Orleans, Philadelphia, and other seaports, who found it more economical to build near cheap timber supplies than near the coast. In 1805, for the same reason, the United States Navy negotiated contracts with several Ohio valley shipbuilders for the construction of sixty-foot, sloop-rigged gunboats for harbor and coastal patrol.

Edward W. Tupper of Marietta accepted a contract for two gunboats from the Navy in 1805, laid the keels in September of that year, and, after delay until the crisis attending the Burr conspiracy had been resolved, launched the two gunboats in early 1807. The gunboats, under command of naval officers, descended the rivers to New Orleans on the spring flood of 1807, and at New Orleans full rigging and sails were raised, cannon were mounted, and each boat manned with a crew of twenty-five sailors. About sixteen Navy gunboats, some fully equipped and some only partly completed, were built by Ohio River shipcarpenters and taken to New Orleans for commissioning between 1807 and 1809. Most of these were used by the Navy for harbor patrol and customs enforcement along the Gulf Coast.



—*Campus Martius Museum*
Ohio Historical Society

Sailing ships at the mouth of the Muskingum River where it joins the Ohio River at Marietta.



River scene showing a flatboat and two keelboats. Note poles being used to propel keelboat against powerful river currents. Use of the poles made the keelboat the most important freight hauling vessel in the early days of river traffic. Sails propel the other keelboat, demonstrating the versatility of these boats.

The Embargo on foreign commerce in 1808 and the War of 1812 caused a recession in the Ohio River shipbuilding industry, but ships were built on the Ohio and its tributaries from time to time until 1865. A sloop was built on the Hocking River at Athens, a schooner at the mouth of the Guyandotte River, and several vessels at Portsmouth, Ohio, Vanceburg, Ky., and other ports along the rivers. The Marietta Ship Company launched several ships between 1844 and 1850 that sailed to Africa, possibly to become slavers; and at Cincinnati the 850-ton *Minnesota*, perhaps the largest sailing ship built on the Ohio, was completed for the foreign cotton trade in 1848. Construction of sailing ships in the Ohio valley ended in 1865, when the *Mary Belle Roberts* floated downriver.

Prowess of the Keelboat

Neither sailing ships nor flatboats, however, could challenge the powerful currents of the Ohio and Mississippi rivers, and Ohio valley merchants and navigators looked elsewhere for a solution to the problem of establishing a dependable upriver commerce for the transportation of imported commodities. John Filson, pioneer Kentucky historian, estimated in 1784 the costs of importing commodities from Atlantic port cities across the Appalachians by pack animals and wagons and down river in flatboats to Ohio valley settlements amounted to as much as $200 a ton. Efforts were then being made to bring goods from New Orleans in bateaux with some success, but the capacity of bateaux was so limited that transportation costs were still exorbitant.

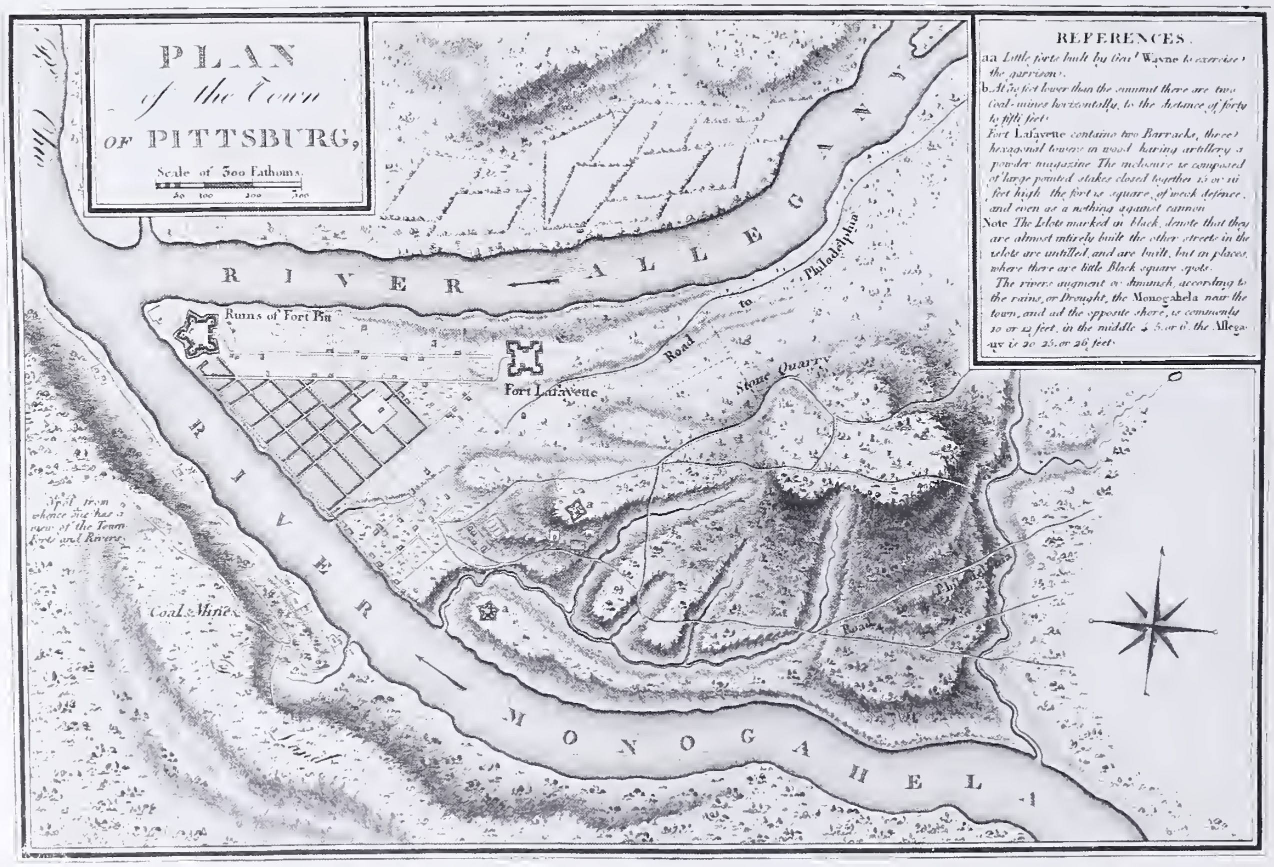
By 1792, to meet the demand for a more economical means of upriver navigation, inland river boatbuilders had introduced the long, sleek keelboat, ribbed and planked like a ship, with a heavy timber keel and pointed prow to permit easier navigation against the rolling currents of the Ohio and Mississippi rivers and over the shallows and rapids of their tributaries.

Keelboats ranging from thirty to seventy-five feet long and from five to ten feet wide, with cargo capacities of up to forty tons, were plying the Ohio River in large numbers by 1800. The model keelboat hull was covered with an arched cabin for protection of the cargoes, with small decks at each end and a narrow runway along each side. Sails were used whenever possible, but keelboats were usually propelled by men pushing on the bottom of the river with long iron-tipped poles.

To "pole" a keelboat upstream, each husky crewman stabbed a pole into the riverbed, braced it against his shoulder, and walked the boat upriver under his feet until he reached the stern. He then picked up the pole, walked back to the bow, and repeated the process. "Poling," with crewmen moving in line one by one like a slow-turning carousel, could force a keelboat upriver at a snail's pace.

The boats ordinarily ran near the banks, out of the swifter currents, and the crewmen might then resort to "bushwhacking"—pulling the branches of overhanging trees to drag the boat along. Where currents were too strong for sailing, poling, or bushwhacking, the boatmen attached long ropes, called "cordelles," to the bow or mast of the boats and towed them upstream from the banks, clambering around or over drift piles and brush and wading through tributary creeks. At times, boatmen also "warped" the boats upriver by tying ropes to upstream trees and pulling hard from the bow of the boat.

Keelboatmen, proverbially profane, intemperate, and dissolute, alternately pulled, poled, dragged, and sometimes sailed from New Orleans to Ohio River ports in two to three months, with huge expenditure of human energy but frequently large profits. An Ohio River keelboat captain said in 1817 he could pole a thirty-six ton keelboat with a crew of fourteen up from New Orleans at a cost of $1,750, grossing $3,240 on his cargo at $90 a ton and netting $1,490 per trip on a capital investment of $2,000 or less. Profits such as this were encouraging, and a few very large keelboats, called "barges," frequently poled by as many as fifty men and carrying up to a hundred tons, entered the New Orleans river trade.


PLAN of the Town OF PITTSBURG,
Scale of 500 Fathoms.
50 100 200 300
REFERENCES.
aa Little forts built by Genˡ Wayne to exercise the garrison.
b At 30 feet lower than the summit there are two Coal-mines horizontally, to the distance of forty to fifty feet.
Fort Lafayette contains two Barracks, three hexagonal towers in wood having artillery a powder magazine The inclosure is composed of large pointed stakes closed together 15 or 16 feet high the fort is square, of weak defence, and even as a nothing against cannon
Note The Islots marked in black, denote that they are almost intirely built the other streets in the islots are untilled, and are built, but in places, where there are little Black square spots.
The rivers augment or diminish, according to the rains, or Drought, the Monogahela near the town, and at the opposite shore, is commonly 10 or 12 feet, in the middle 4 5, or 6. the Allegany is 20 25, or 26 feet.
Ohio
RIVER ALLEGANY
Road to Philadelphia
Ruins of Fort Pitt
Fort Lafayette
Stone Quarry
RIVER MONOGAHELA
Spot from whence one has a view of the Town Forts and Rivers
Coal Mines
Road
a
b

—"A Journey in North America; Atlas"
Victor Collot–1826

Plan of the Town of Pittsburgh in the Early 1800's, where the Allegheny and Monogahela Rivers flow together to form the Ohio River.

Freight rates on commodities carried in keelboats and barges were high, but still substantially less than those charged on goods brought over the mountains from Eastern cities.

In addition to the long-distance trade with New Orleans, keelboats also supplied settlements far up many Ohio River tributaries. On the Muskingum River, with the aid of teams of oxen at difficult shoals such as Luke Chute, Silver Heels, and Slippery Rock, a regular keelboat commerce was established, carrying manufactured goods and groceries to Zanesville and above. Keelboats on the Kanawha River commonly navigated to Charleston and the saltworks between Charleston and the Falls of the Kanawha.

Loammi Baldwin, Virginia State Engineer, described in these words, in 1817, the keelboat commerce on the Kanawha: "In coming up, the boat is kept along the bank of the river, and the boatmen walk on the top, take hold of the brush and draw the boat forward, or shove with poles. The labour of shoving becomes very hard in ascending the channels of the shoals, where the water is shallow and the current very rapid. Barges, and some of the keelboats occasionally use large square sails when the wind blows up stream, with which they ascend even the shoals with surprising velocity."

Despite the herculean efforts required to force keelboats upstream, the keelboat trade was successful and profitable in its day for the same reason waterways commerce was growing in the late twentieth century—lower transportation costs. Keelboats eventually lost passenger traffic and long-distance freight to steamboats, but for short distances and near the headwaters of tributaries, where steamboats dared not compete, keelboats and the similar "pushboats" were used for commercial navigation until improved roads and railroads were built, near the end of the nineteenth century.

From canoe and bateau to flatboat, sailing ship, and keelboat, the Ohio River and its tributaries served as the principal arteries of transportation and commerce of the first pioneers and merchants in the valley. Canoes carried small cargoes of high value, bateaux provided greater stability and capacity, flatboats supplied the need for large vessels for downriver travel and trade, sailing ships opened easier access to international markets, and keelboats permitted a difficult but effective upriver commerce at reduced transportation costs. Despite dangers of Indian attack in the very early periods, robbery in secluded places, and uncertain markets, in spite of the dangers of shoals, rapids, snags, and other obstructions in unimproved river channels, the waterways of the Ohio valley region became the principal route followed by the "Great Migration" to the West, and, because their currents swept to the sea, they also became the key to early regional economic development and prosperity.

Improving the Natural River

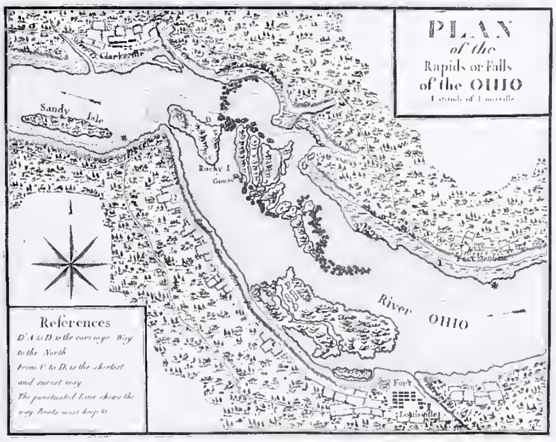
Pioneer navigators were undismayed by the risks attending use of the rivers, for in comparison with the primitive overland trails the risks and costs were much less, and when navigation was impeded they performed their own improvement projects, scraping channels through bars and removing the worst obstructions.

When steamboats were introduced on the rivers, however, and facilitated upriver commerce, doubling the value of waterway navigation, the risks accompanying river navigation became a matter of great concern and the delays caused by low water began to have serious and widespread effect on commercial life in the region.

The Corps of Engineers, United States Army, was assigned the mission of improving Ohio River navigation in 1824, and by that date, because of the studies made by pioneer Engineers, the Corps had accumulated a substantial fund of information regarding the problems of inland river navigation.

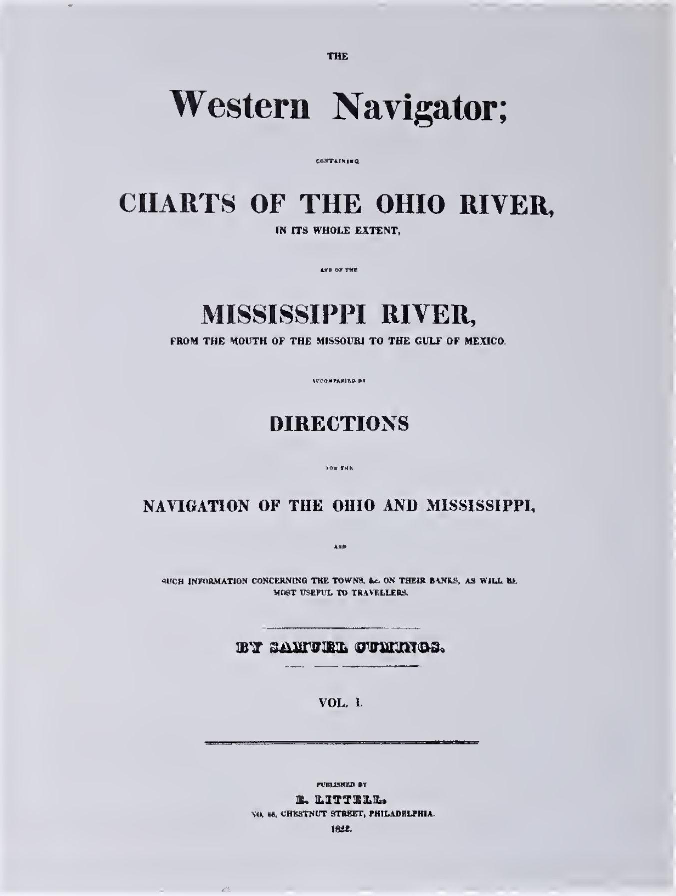
Thomas Hutchins' topographic and hydrographic studies of the Ohio River and valley resources had as much influence on the early settlement of the region as that of any other American frontiersman, and Rufus Putnam, Chief Engineer of the American Army, made a vital contribution to the settlement of southern Ohio.

Topographic mapping functions, hydrographic and navigation studies, and military construction, first performed by individual Army Engineers in the Ohio valley in the eighteenth century, still were important elements of the Army Engineer program in the valley in the twentieth century. Perhaps, along with explorers, hunters, traders, and pioneers, the role of the Army Engineers on the Ohio valley frontier deserves wider recognition.


PLAN
of the
Rapids or Falls
of the OHIO
Clarksville
Sandy Isle
D
Rocky I
River
OHIO
Fort
Louisville
References
D'A to D is the carriage Way to the North
From C to D is the shortest and surest way
The punctuated Line shows the way Boats must keep to

—*"A Journey In North America; Atlas"*
Victor Collot–1826

Plan of the Rapids or Falls of the Ohio River at Louisville, Kentucky,



THE

Western Navigator;

CONTAINING

CHARTS OF THE OHIO RIVER,
IN ITS WHOLE EXTENT,

AND OF THE

MISSISSIPPI RIVER,
FROM THE MOUTH OF THE MISSOURI TO THE GULF OF MEXICO.

ACCOMPANIED BY

DIRECTIONS

FOR THE

NAVIGATION OF THE OHIO AND MISSISSIPPI,

AND

SUCH INFORMATION CONCERNING THE TOWNS, &c. ON THEIR BANKS, AS WILL BE
MOST USEFUL TO TRAVELLERS.

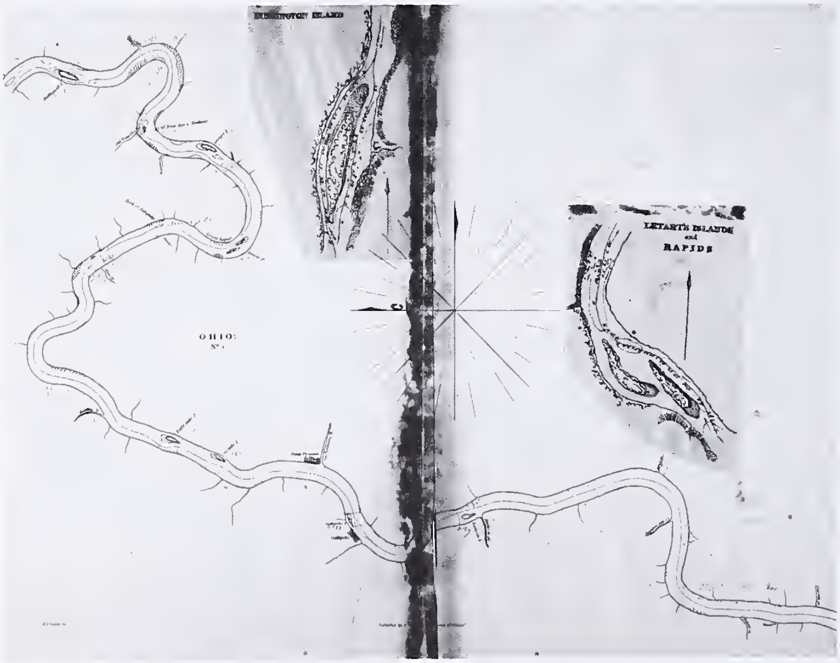
BY SAMUEL CUMINGS.

VOL. I.

PUBLISHED BY
E. LITTELL.
NO. 88, CHESTNUT STREET, PHILADELPHIA.
1822.

Title Page of The Western Navigator

—Samuel Cumings



A Map of the Section of the Ohio River Showing Letart Islands and the Rapids. These were considered to be the worst rapids and the greatest hazard in the river above the great falls at Louisville.

—The Western Navigator
Samuel Cumings

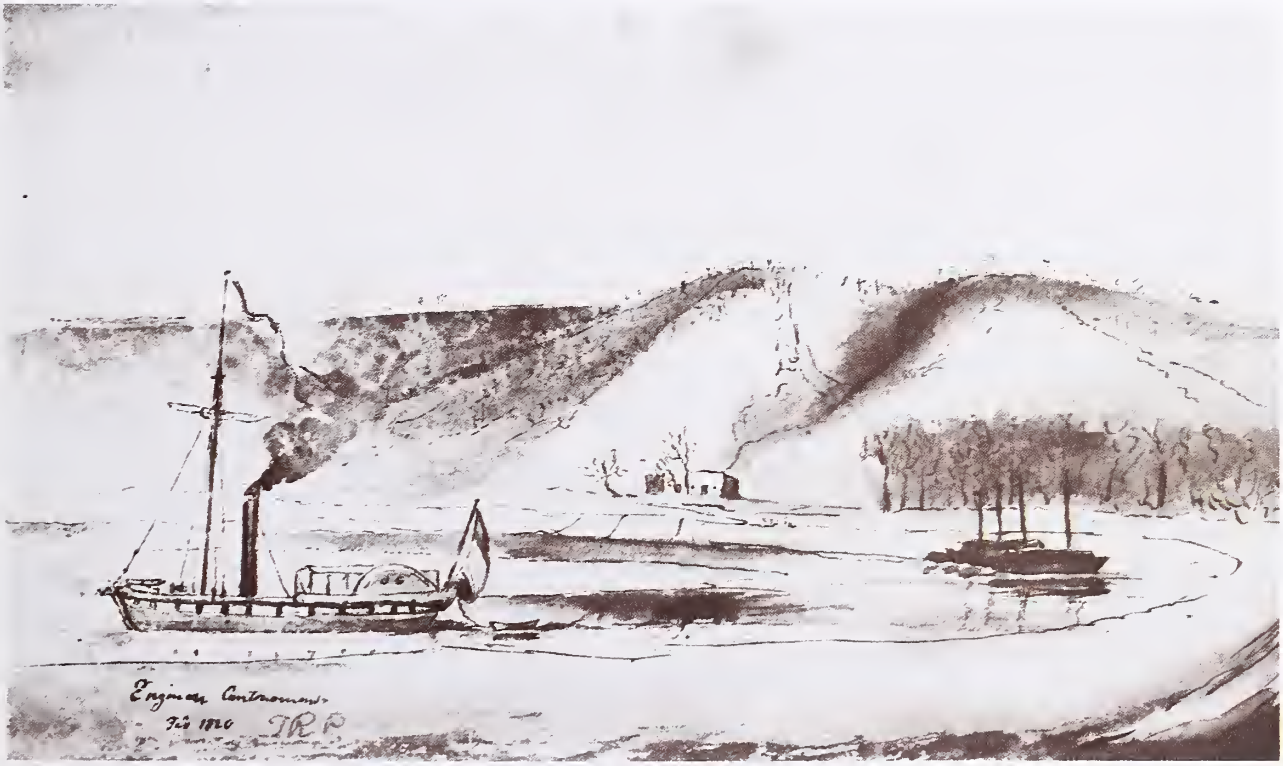
Chapter II

Steamboats and Waterways Engineering

Huge, black, scaly, the gigantic serpent blasted steam from its gaping mouth as it thrashed down the Ohio River, white foam dashing violently behind. Even more surprising were the men calmly striding along its back with notebooks in hand, the brass cannon glistening at its head, the black howitzers mounted along its sides—for this infernal machine was but a unique steamboat in serpentile disguise. Built by Major Stephen H. Long of the Army Corps of Engineers at the Army Arsenal on the Allegheny River, the *Western Engineer* was launched in early 1819 to carry Major Long, his fellow officers, and a distinguished task force of scientists, naturalists, and artists on an expedition to explore the frontier and to collect military intelligence, scientific data, and information about inland river navigation.

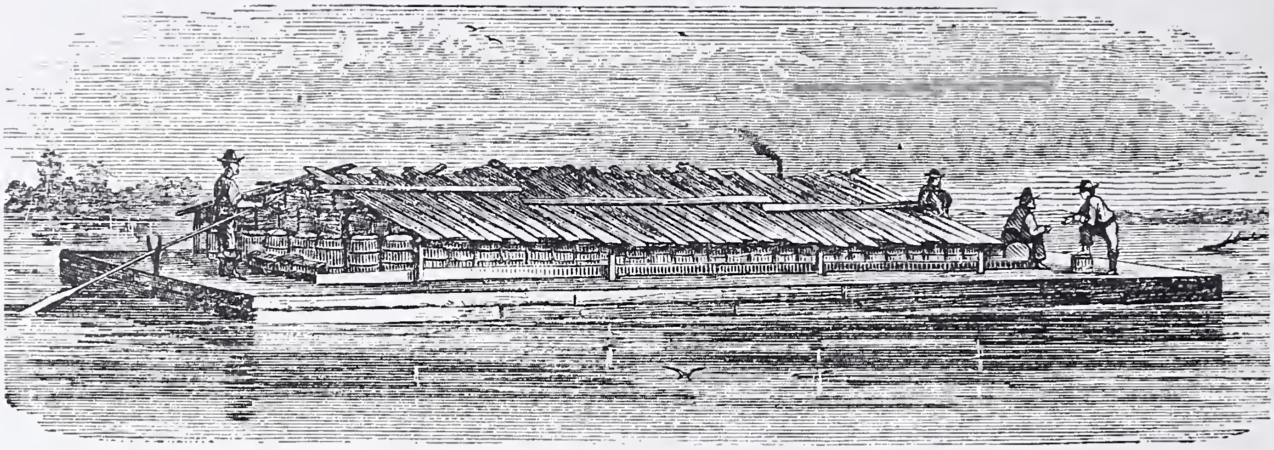
Major Long, a Dartmouth graduate who joined the Corps of Engineers during the War of 1812, had explored the Western rivers in a skiff in 1816 and 1817 and become well acquainted with the hazards of river travel. When ordered in 1818 to lead a military reconnaissance and scientific expedition to the frontier, Major Long planned the building of the experimental *Western Engineer* to transport the expedition as far west as possible by water, while at the same time developing an improved steamboat specially designed to overcome the peculiar problems—narrow, shallow, snag-littered channels—of inland river navigation.

Novel engineering and design features of the *Western Engineer* included a cam-cutoff in the engine to afford increased power for pushing against swift currents, a paddlewheel built into

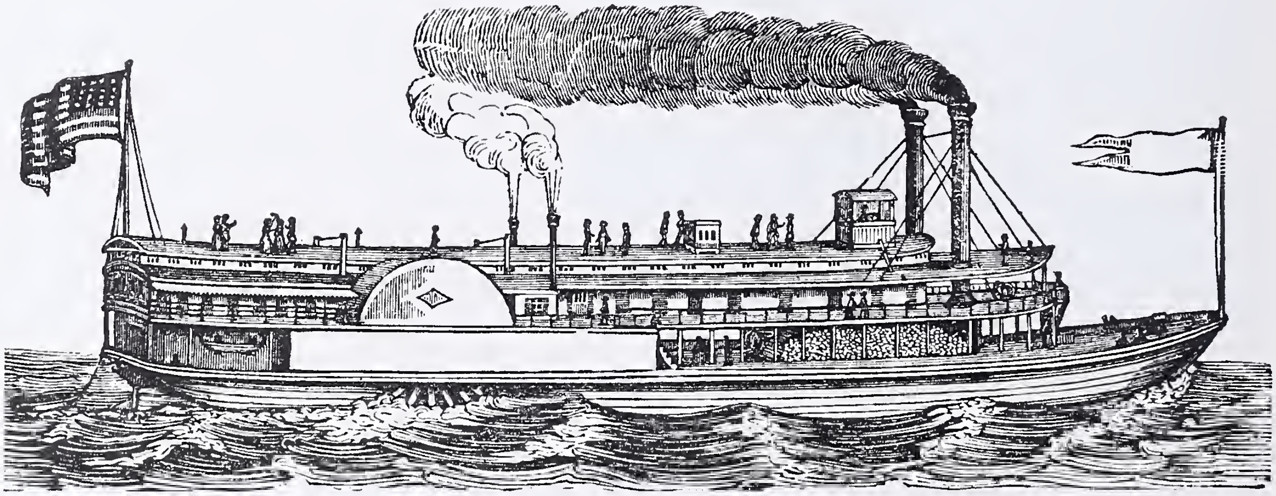


—Tilton R. Peale; American Philosophical Society Library, Philadelphia

U.S. Western Engineer constructed by Major Stephen H. Long in Pittsburgh, Pennsylvania, 1818–1819.



Flatboat



Steamboat —*Eighty Year's Progress of the United States, 1867*

With the arrival of steamboats travel time greatly decreased. A trip from New Orleans to St. Louis by flatboat took 4 months but was made in only 3 days by steamboat.

the stern to reduce the danger of damage from snags, and a seventy-five- by thirteen-foot hull with machinery carefully distributed to achieve a draft of merely nineteen inches, to permit greater maneuverability in the tortuous and shallow channels of the inland rivers.

Because encounters with hostile Indians were expected on the frontier, Major Long installed a bulletproof pilothouse, mounted a cannon on the bow, placed howitzers along the sides, armed the crew with rifles and sabers, and adopted a unique serpent-like design to surprise and awe the natives. Flying the banner of the Republic and a pennant depicting a white man and Indian shaking hands, and with steam spurting through the mouth of the serpent-head carved on the bow and heavy smoke billowing from its stack, the *Western Engineer* must have appeared a nightmare to the Indians, and to other beholders as well.

The new engineering features and the very shallow draft of the *Western Engineer* made it the prototype of the western river steamboats that, it was later said, could navigate on a "heavy dew." It was built, however, some seven years after the first steamboat made its way down the inland rivers, and in those seven years many improvements had been made.

Steamboats Introduced on the Ohio

The heavy labor of upstream navigation in keelboats, and the pressing need for more economical transportation, had led many rivermen to experiment with mechanical boats, often propelled by horses turning shafts geared to paddlewheels. But on the Ohio it had been found that horses lacked the stamina of keelboatmen over the long haul, and horsepowered boats had been relegated to crossriver ferry service.

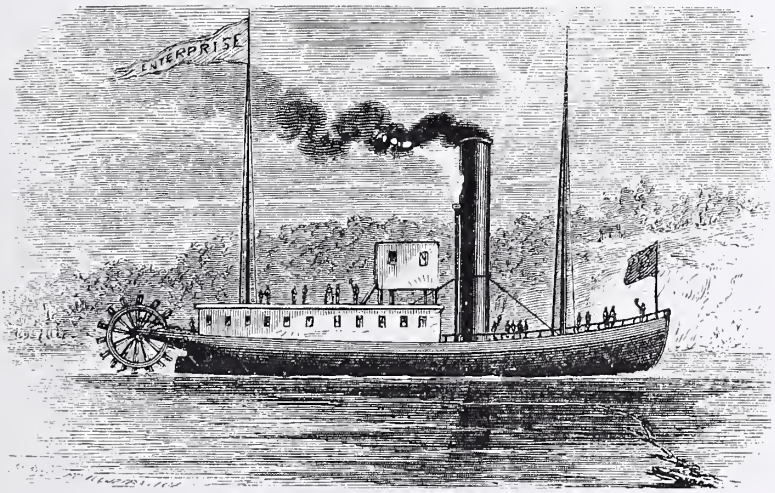
Powering boats with steam engines was also attempted with some success in the late eighteenth century. Thomas Hutchins and Andrew Ellicott of the Army Engineers were fascinated with the steamboat developed by John Fitch about 1784 and brought the invention to the attention of Congress in an effort to obtain financial support for further experiments. But the steam-propelled boats devised by John Fitch, James Rumsey, and other bold engineers had only limited success, and credit for the invention (1807) of a practical steamboat has generally gone to Robert Fulton. With the backing of New York capital, Fulton put a steamboat into profitable operation on the Hudson River and organized a company to build such boats on the inland rivers.

Nicholas J. Roosevelt, representing the Fulton company, flatboated down the Ohio and Mississippi in 1809 to inspect the channels, observe the currents, and gage the prospects for steamboat trade. He also opened coal mines at Pomeroy, Ohio, and at other points along the river so it would not be necessary to depend on wood for fuel. Finding the prospects bright for steamboat use, Roosevelt returned to the head of the Ohio to construct the steamer *New Orleans* and direct its voyage downriver to New Orleans in late 1811.

The *New Orleans*, the first steamboat to descend the Ohio, created great alarm and much excitement as people gathered at riverside to see it pass. Many had never before heard of a "steam" boat and were frightened and amazed by what appeared to be a floating sawmill rushing downriver at ten miles an hour. When the vessel landed at Parkersburg, at the mouth of the Little Kanawha River, all one hundred inhabitants of the village turned out to marvel at the ingenuity it represented. After passing the disappearing islands, the caving banks, and the new channels created by the New Madrid earthquake of 1811, the *New Orleans* reached the city of its name in early 1812 and entered a profitable trade on the lower Mississippi River.

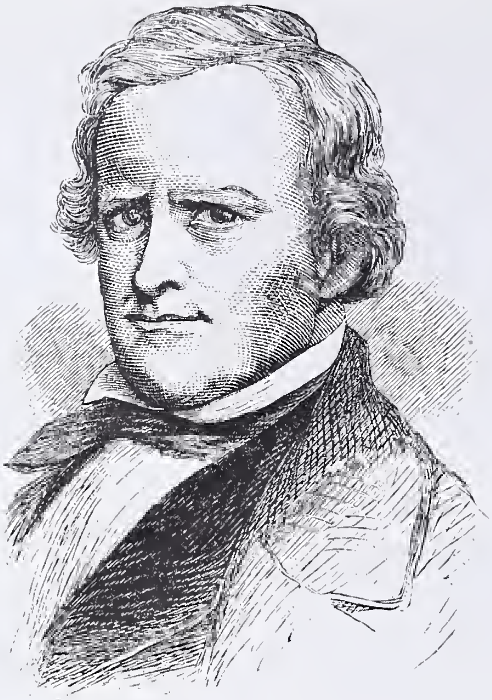
Encouraged by the success of the *New Orleans*, the Fulton company built other steamboats, planning to operate them in relays from the head of the Ohio to the mouth of the Mississippi. The company also sought exclusive rights to steamboat navigation on the inland rivers, and was granted such a monopoly by the Territory of Louisiana on the lower Mississippi. Opposition to the proposed monopoly was vehement, however, in the Ohio valley. Kentucky and Ohio protested to Congress, and Ohio enacted retaliatory legislation prohibiting Fulton boats from landing passengers in the state. Independent rivermen directly challenged the monopoly by building their own steamboats, and fought the monopoly in the courts, basing their case chiefly on the argument that navigable rivers and interstate commerce were under Federal jurisdiction, and that states could not grant monopolistic navigation privileges to any company.

Captain Henry M. Shreve has generally been credited with breaking the back of the Fulton monopoly. Shreve, a rugged keelboat and barge commander, took charge of the little forty-five-ton steamboat *Enterprise*, built by Daniel French on the Monongahela River, in late 1814, and rushed a precious cargo of munitions and military supplies to the army of General Andrew Jackson, then facing a British army at New Orleans. After delivering these supplies, Shreve then raced back upriver to take keelboats loaded with small arms in tow and hasten them to New Orleans. General Jackson then sent Shreve and the *Enterprise*, under cover of fog and darkness, in a daring dash



French's Steamer "Enterprise" in 1814 was the first boat to ascend the Mississippi and Ohio Rivers.

—"Up the Heights of Fame and Fortune:" by Frederick B. Read, 1873



Henry M. Shreve, Steamboat Captain contributed more to the development of the unique Western River Steamboat than any other pioneer marine engineer.

Henry M. Shreve

—"Up the Heights of Fame and Fortune;" by Frederick B. Read, 1873

under the fire of British batteries to resupply an American fort, and after Shreve safely returned to New Orleans, the General allowed him to join the line which met the British assault.

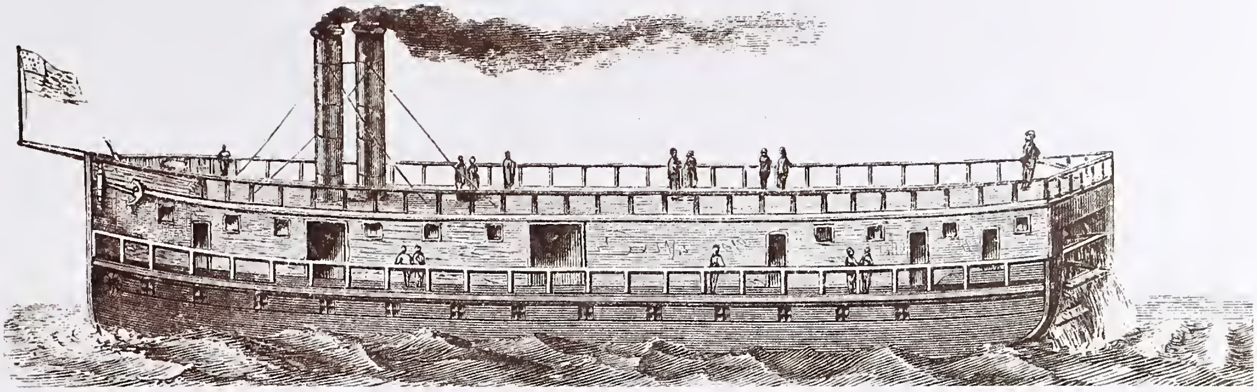
After the city had been saved, attorneys for the Fulton company obtained a court order and seized the *Enterprise* for violating its exclusive rights. Captain Shreve made the necessary bail, fired up the *Enterprise*, turned its bow homeward, and in May and June 1815 completed the first successful steamboat trip *up* the Mississippi and Ohio rivers.

The upriver voyage of the *Enterprise*, a very small boat, did not necessarily prove a profitable two-way steamboat trade with New Orleans could be established, and Shreve undertook to build a larger, more powerful boat which could overcome rapid river currents and carry sufficient cargo to make the trips profitable. He built the *Washington* in 1816, with hull timbers from old Fort Henry at Wheeling and a new engine and propulsion system; he placed the engine cylinder in a nearly horizontal position and connected it to the paddlewheel with a pitman, a system which became basic to Western steamboat design.

The maiden voyage of the *Washington*, was, however, a near disaster. At Marietta in June 1816 the boat blew a cylinder head, scalded some of the crew to death, and blasted the captain overboard. Shreve climbed back aboard, repaired the cylinder, and set out again down the Ohio, only to lodge on a bar a few miles below Maysville, where the boat lay until a rise floated it off in September. Upon reaching New Orleans, the *Washington* was attached and Shreve was arrested at the instance of the Fulton company. The Fulton interests offered Shreve a large interest in their company, if he would deliberately lose the case in court, but, with characteristic bluntness, he spurned the bribe, losing a fortune it was said, but gaining the everlasting gratitude of Western rivermen.

In 1824 the Supreme Court issued a landmark decision against the Fulton company, freeing river navigation from the shackles of special privilege. The fiery river captain finally completed his trip to New Orleans and back in the *Washington*, and he made several other profitable trips in the boat, generating great public interest in the economic potential of the steamboat and stimulating a boom in steamboat construction.

The *General Pike* established the first regular steamboat packet service on the Ohio River in 1818, running from Maysville to Cincinnati to Louisville. In 1819 Shreve challenged the captain



—"Up the Heights of Fame and Fortune"
by Frederick B. Read, 1873

The "General Pike" established the first regular packet service on the Ohio River in 1818, running from Maysville to Cincinnati to Louisville.

of the *Pike* to one of the first of the now-classic steamboat races. With a thousand dollar prize at stake, Captain Shreve held down the safety valve, blued the air with verbal encouragement to the stokers to keep the fires roaring, and was holding a narrow lead when the *General Pike*, whose captain must have been using similar tactics, blew up, with much loss of life. His victory turned to ashes, Shreve became a highly vocal advocate of steamboat safety laws and safer channels for navigation.

Attainments of the Western Engineer

Thus, when Stephen Long built the *Western Engineer* in 1819, much had already been done to develop steamboats suitable for the inland rivers, but the vessels built by the Fulton company, Shreve, and other pioneer inland marine engineers had drafts too great for easy navigation on shallow streams. The *Western Engineer*, drawing but nineteen inches, as compared with four to six feet for earlier boats, marked an important step in the development of steamboats on the Western rivers.

Major Long, his six-man crew, nine artillerists, and a complement of officers and scientists, embarked in the *Western Engineer*, accompanied by keelboats transporting the Sixth United States Infantry, in May 1819. High winds slammed the boat into the riverbank near Maysville, but the trip down the Ohio was completed without other mishap.

During the trip, Major Long improved the mechanical operation of the boat and landed at various points to permit the scientists to make observations and collect specimens and data. At Marietta, Indian mounds back of the town were examined; at Gallipolis, native flora was inspected; and Long made careful study of Ohio River navigation problems.

From the mouth of the Ohio, the expedition ascended the Mississippi and Missouri rivers into Nebraska, farther than any steamboat had ever before penetrated, proving the value of the light-draft design of the *Western Engineer*.

Major Long made a personal report on Ohio River navigation to the Secretary of War, for in 1819 considerable public pressure was building for swift federal action to improve navigation on the inland rivers. Long described the problems with characteristic precision:

> The obstructions to its navigation are sandbars, some few rafts, snags and rapids, to which the intricacy of its channel in several places may be added. During a middle and high stage of water the obstructions entirely disappear, and an accelerated current is the only difficulty to be encountered. The average velocity of the current in a moderate stage of water may be estimated at 2-1/2 miles, and in a high stage at 3 miles per hour. The season in which the navigation of the Ohio, can be relied on commences between the middle of February and the first of March, continues to the latter part of June. A Fall freshet usually takes place in October or November and the river is again navigable for a few weeks.
>
> During the rest of the year boats of inconsiderable burden meet with numerous obstructions, in their progress, from the lowness of the water, and in many places no channel can be found of sufficient depth to admit their passage.

Major Long had expected the *Western Engineer* on its return trip to steam up the Ohio River, but found the stage too low even for a boat of nineteen-inch draft, for during late 1819 and early 1820 no fall rise occurred, the spring rise was late, and Ohio valley community and commercial affairs were almost brought to a standstill.

By 1819 the Fulton monopoly had crumbled, an unparalleled steamboat construction boom was under way, and the Ohio valley economy had become largely dependent on the waterways for an outlet to market. The hazards of inland river navigation were no longer merely an irritant, patiently borne by navigators and shippers as an unavoidable evil.

Captain John Sanders, Corps of Engineers, later summarized the reasons for growing public concern about the risks of navigation in the decade after the War of 1812 in these words:

> Previous to the war of 1812, the commerce of the Ohio Valley was not so extensive, nor the means for its transportation so certain and rapid, as to call for any artificial extension of the cheap and easy transit afforded in time of freshets and floods; but the introduction of its population and its productions, and the opening of so many lines of communication with the Atlantic sea-board, made any interruptions to the navigation, arising from insufficiency of water, caused by the long droughts of summer and autumn, to be severely felt by all the business and traveling community.

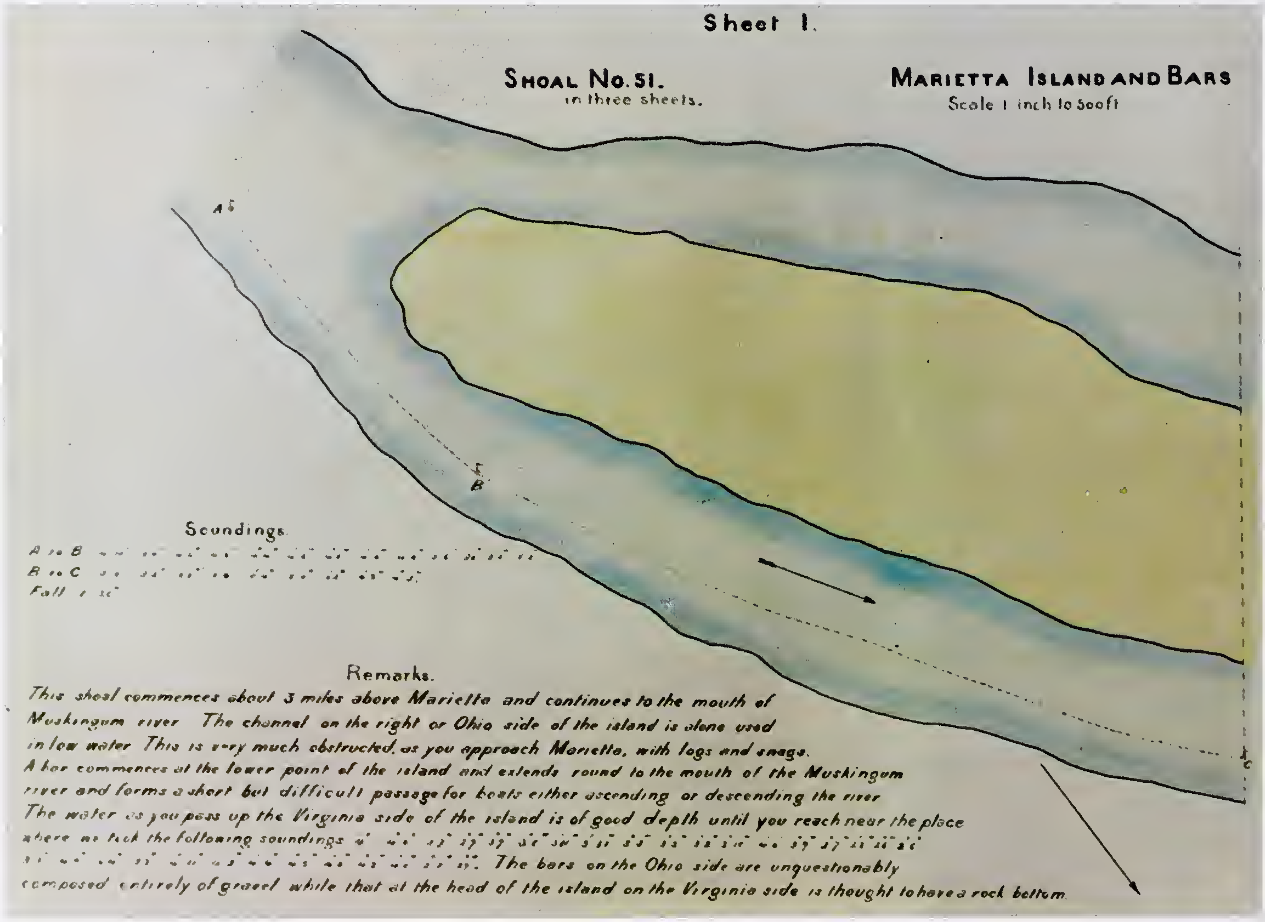
On December 7, 1818, over three million dollars worth of commodities and a huge crowd of immigrants and travelers lay in wait at upper Ohio River ports for a rise in the river; and a newspaper editor commented: "A clearing out of the river, so as to render it navigable at all seasons for vessels of fifty tons, is spoken of as practicable."

The beautiful Ohio became La Belle Creek in 1819, when from April until February of 1820 navigation on the Ohio and its tributaries was suspended, with disastrous consequences for boatowners, shippers, and industry in the valley.

A Joint State River Study Commission

Such disruptions to an otherwise thriving trade were becoming intolerable, and states touching the Ohio valley began to urge federal action to alleviate river-caused economic recessions.

First to act was the General Assembly of Ohio, which passed a joint resolution in 1817 declaring the time had come for states bordering the Ohio River to unite in support of navigation improvement, directing the Ohio delegation in Congress

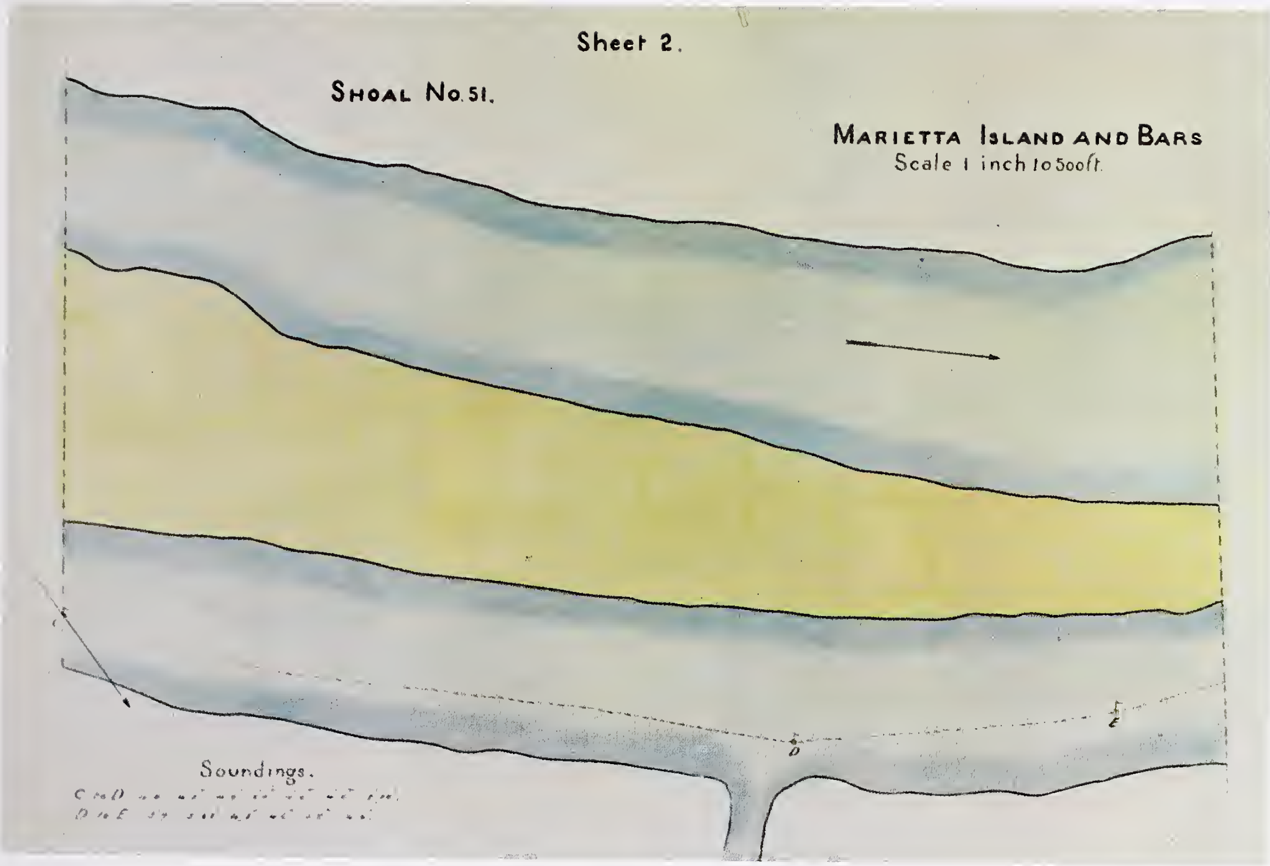


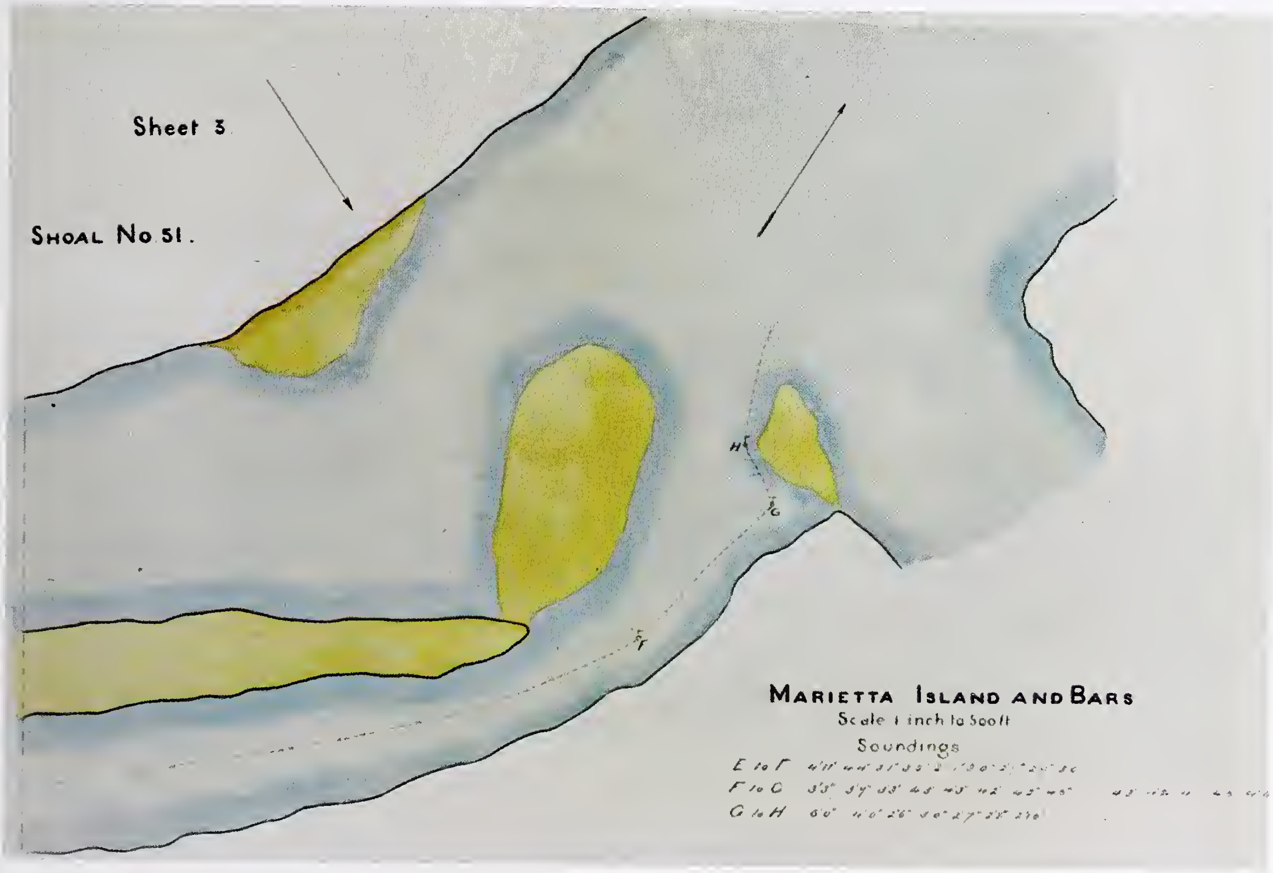
Remarks.

This shoal commences about 3 miles above Marietta and continues to the mouth of Muskingum river The channel on the right or Ohio side of the island is alone used in low water This is very much obstructed, as you approach Marietta, with logs and snags.
A bar commences at the lower point of the island and extends round to the mouth of the Muskingum river and forms a short but difficult passage for boats either ascending or descending the river
The water as you pass up the Virginia side of the island is of good depth until you reach near the place where we took the following soundings [illegible]. The bars on the Ohio side are unquestionably composed entirely of gravel while that at the head of the island on the Virginia side is thought to have a rock bottom.

—National Archives

3 charts for the reconnaissance of the Ohio River above the falls. Made in 1819 by commissioners appointed by the States of Virginia, Kentucky, Pennsylvania and Ohio.


Sheet 2.
Shoal No. 51.
Marietta Island and Bars
Scale 1 inch to 500 ft.
C
D
E
Soundings.
C to D
D to E


Sheet 3
Shoal No. 51.
H
G
F
Marietta Island and Bars
Scale 1 inch to 500 ft
Soundings
E to F
F to G
G to H

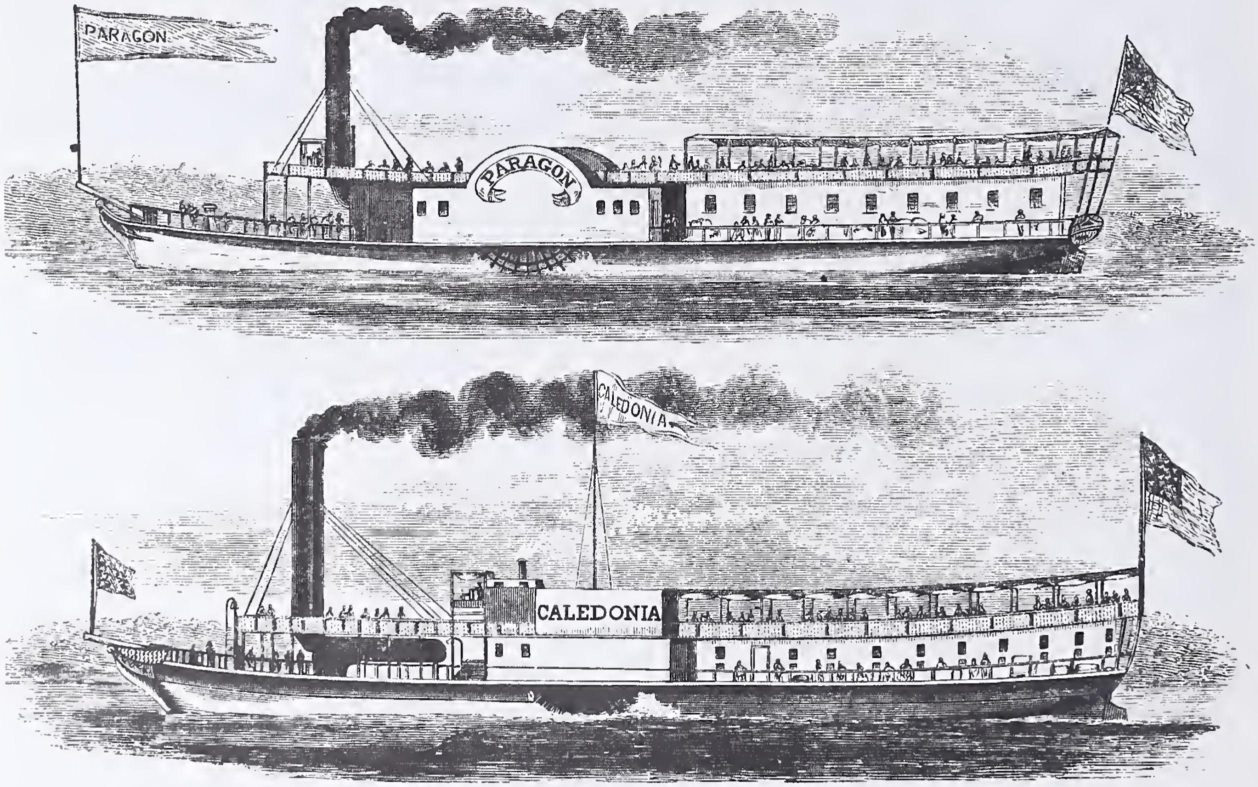
to support appropriations for inland rivers, and urging other states to join with Ohio in appointing a joint commission to survey the upper Ohio, report its condition for navigation, and recommend measures to ease waterway transportation embarrassments.

Several states had acted on the Ohio resolution by early 1819 and appointed representatives to the joint state commission: Kentucky appointed General John Adair; Pennsylvania chose State Senator Walter Lowrie; Virginia selected General Samuel Blackburn; and Ohio appointed Edward W. Tupper, the Marietta ship and gunboat builder. Members of the commission met in Pittsburgh in August 1819 and surveyed the river from its head to the Falls of the Ohio, mapping 102 of the worst obstructions to navigation. They returned to Gallipolis, Ohio, wrote their report, and signed it on November 2, 1819.

The commission recommended removing snags, blasting chutes through rocky shoals, and dredging channels through sand and gravel bars, and suggested that each participating state contribute $10,000 to establish a $40,000 project fund. The benefits of improving Ohio River navigation would, in the opinion of the commissioners, be overwhelming. They described the "painful spectacle" of steamboats and lesser craft stranded on river bars, rotting to the waterline, "whilst through a fertile and populous region of 1000 miles in extent, the commerce and interchange of domestic commodities are completely embargoed"

General Blackburn of Virginia said he saw over thirty steamboats, representing invested capital of more than two million dollars, "worse than dead, ruinously expensive to their owners, lying in all directions, chiefly high and dry, some half in and half out of water, all sustaining incalculable injury." He said that improving Ohio River navigation, while indispensable to all Ohio Valley states, was imperative for Virginia, then planning to improve Kanawha River navigation and to join the Kanawha with the James River, by road or canal. A James and Kanawha project might be entirely worthless, he said, if commodities were to be delayed six to eight months at the mouth of the Kanawha awaiting a river rise.

General John Adair, who became Governor of Kentucky just after completion of the survey, told the Kentucky legislature that improved Ohio



—*"Up the Heights of Fame and Fortune"*
by Frederick B. Read, 1873

Ohio and Mississippi steamers typical of the one used by the Fulton Company in the early days to operate in relays from the head of the Ohio to the mouth of the Mississippi.

River navigation would doubly reimburse the costs of the project the first year after completion. Governor James Preston of Virginia predicted the improvement of the Ohio would stimulate industrial, mercantile, and agricultural activities in western Virginia.

But the only action taken by Kentucky, Virginia, and Ohio was to appeal to Congress for a federally funded project. Pennsylvania, however, took independent action and spent $15,000 in clearing a narrow channel from Pittsburgh to Wheeling.

Congress responded in 1820 to public interest in improving inland river navigation by appropriating $5,000 to continue the survey begun by the joint state commission in 1819. A board of engineers—General Simon Bernard, Colonel Joseph Totten, and Captain William Tell Poussin—traveled to the Falls of the Ohio (Louisville) where the state survey had ended in 1819, planning to continue the survey from the deck of the *Western Engineer*. The Engineer serpent-steamer was under repair, however, and the board made its survey in a keelboat, departing the Falls of the Ohio in October and arriving at New Orleans in December 1821.

The engineer board found the lower Ohio navigable for boats drawing less than five feet during six months of each year, but the upper Ohio, with steeper gradient and lesser flow, had more shoals and shallower depths. Snags, the riverman's nightmare, with deadly pointed branches ready to pierce the hull of any passing boat, were strewn everywhere. The board explained snags were trees that had washed from riverbanks and, because their roots were heavy, had become fixed in the riverbed. "When so fixed as to preserve an immoveable position," the board reported, "they are called 'planters,' but when, being inclined from the vertical, and pressed upon by the current, they move in regular or rather in uninterrupted oscillations, they are called 'sawyers.'"

The Engineers suggested that powerful machinery to break, saw, and raise snags from the rivers might be contrived. At shoals and bars where navigation was impossible at low water, wing dams might be constructed to narrow the channel, concentrate flow, and increase the natural scouring action of the current to clear deeper channels. The board recommended experiments with wing dam structures at bars on the Ohio River to determine their effectiveness.

Waterways Improvement Act on 1824

The Eighteenth Congress, meeting in 1824, represented a new era in American politics, said one Congressman, for it represented millions of new voters who, being citizens of the Ohio valley and frontier states, strongly supported swift federal action to improve transportation. By 1824, because of continued population growth, delegations from Ohio Valley and Western states had achieved sufficient strength to make the regional goal of improved waterway transportation a legislative reality. Some political leaders viewed federal waterway improvement projects as a part of an unconstitutional program of internal improvements, but the proponents of a positive waterways policy asserted that waterways, unlike roads and canals, were under national, not state, jurisdiction. This argument was supported in 1824 by the Supreme Court, which in ruling against the Fulton monopoly decided that regulation of interstate commerce on navigable rivers was a federal responsibility.

Led by Congressmen Henry Clay and Robert P. Henry of Kentucky, armed with the favorable report of the engineer board on improvement of Ohio-Mississippi river navigation, and supported by Westerners who wished improved channels for the benefit of a burgeoning steamboat and waterways commerce, the Eighteenth Congress enacted landmark waterways legislation. Henry Clay proclaimed the Ohio and Mississippi rivers were the "common commercial highways of all who inhabit the vast regions through which they flow." These great rivers, he said, were the property of no state and should be treated as common stock and national property. Congressman Henry warned Congress that if the improvement of the Ohio and Mississippi were not undertaken by the United States it might be performed by a "confederacy" of states. "And who would not shudder," he asked Congress, "to see a combination among the States and Territories composing the valley of the Mississippi, for the protection of a class of interests which were avowed and admitted to be peculiar to themselves?"

Congress and the public in general in 1824 were overly optimistic about the work necessary to improve inland river navigation. Congressman Alexander Smyth of Wythe County, Virginia, for example, thought the work might be done merely by ordering the Navy Department to build another gunboat on the upper Ohio and directing its crew to clear the rivers during the descent to New Orleans. Little was known in 1824 about fluvial hydraulics, waterways engineering was in its infancy, and the only information about river navigation that had much reliability was the report of Major Stephen H. Long and the superficial reports of the joint state commission of 1819 and the engineer board of 1821. Misguided optimism and limited knowledge were to bring the Army Corps of Engineers to the verge of disaster during its first efforts to make the rivers safer and more navigable.

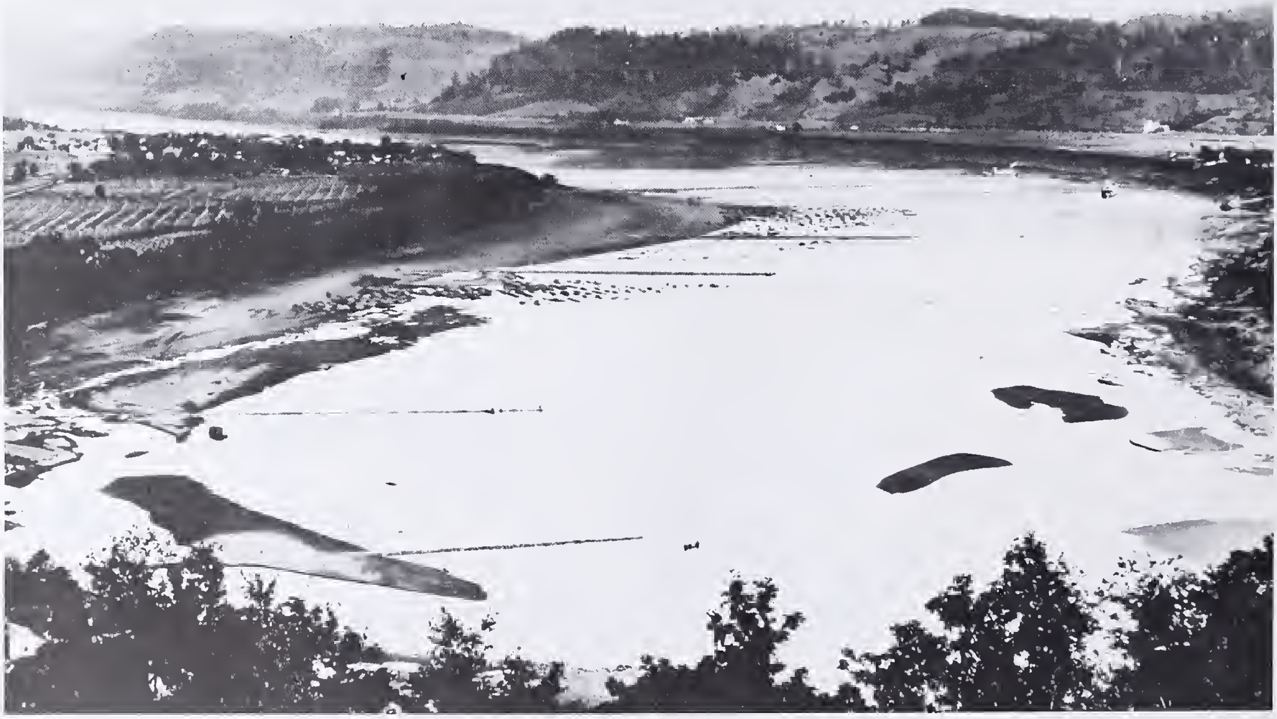
As originally drawn, the Waterways Improvement Bill of 1824 appropriated $75,000 to remove all snags from the Ohio and Mississippi rivers and to establish a three-foot channel throughout the 981-mile length of the Ohio, directing the construction of dikes, sluices, and wing dams at each sandbar and shoal on the Ohio. Henry Clay suggested that supervision of the project be assigned to the Army Engineers and that engineering methods be left largely to their discretion. This was a logical step, for the Army Engineers, with the exception of a few graduates of European engineering schools and men who learned engineering by practice on such projects as the Erie Canal, were the only trained and experienced engineers in the nation—West Point was the only engineering school in the United States until 1825—and one of the chief arguments for improved waterways was the double value of the rivers for interstate commerce and for military logistics. Clay's amendment to the waterways bill was accepted, and the measure enacted on May 24, 1824. The act authorized the President to assign the Army Engineers to the work, directed the performance of experiments at Ohio River bars, and ordered "prompt and effectual" measures to remove all snags from the Ohio-Mississippi waterways.

Henry Clay was not satisfied with the $75,000 appropriated for the project, but was pleased with the principle the bill recognized. The Ohio and Mississippi rivers would henceforward be regarded, he declared, "as our SEAS—as our Atlantic ocean and Mexican gulph, and as such are considered as entitled to special care and attention." Unlike many of his colleagues, Clay recognized that more appropriations would be necessary to complete satisfactorily the project begun in 1824.

Improvement of the Waterways Is Begun

General Alexander Macomb, Chief of the Corps of Engineers (1821-1828), took the necessary "prompt and effectual" action by launching a study of snag removal engineering and dispatching Major Stephen H. Long to the Ohio River to begin experiments with methods of deepening river channels across bars.

Major Long selected a compacted gravel bar on the lower Ohio that had merely fifteen inches of water over it at low water stages for his first



View showing wing dams on the Ohio River, depicting the type built to narrow the channel which increased the volume and velocity of water flowing over the bar.

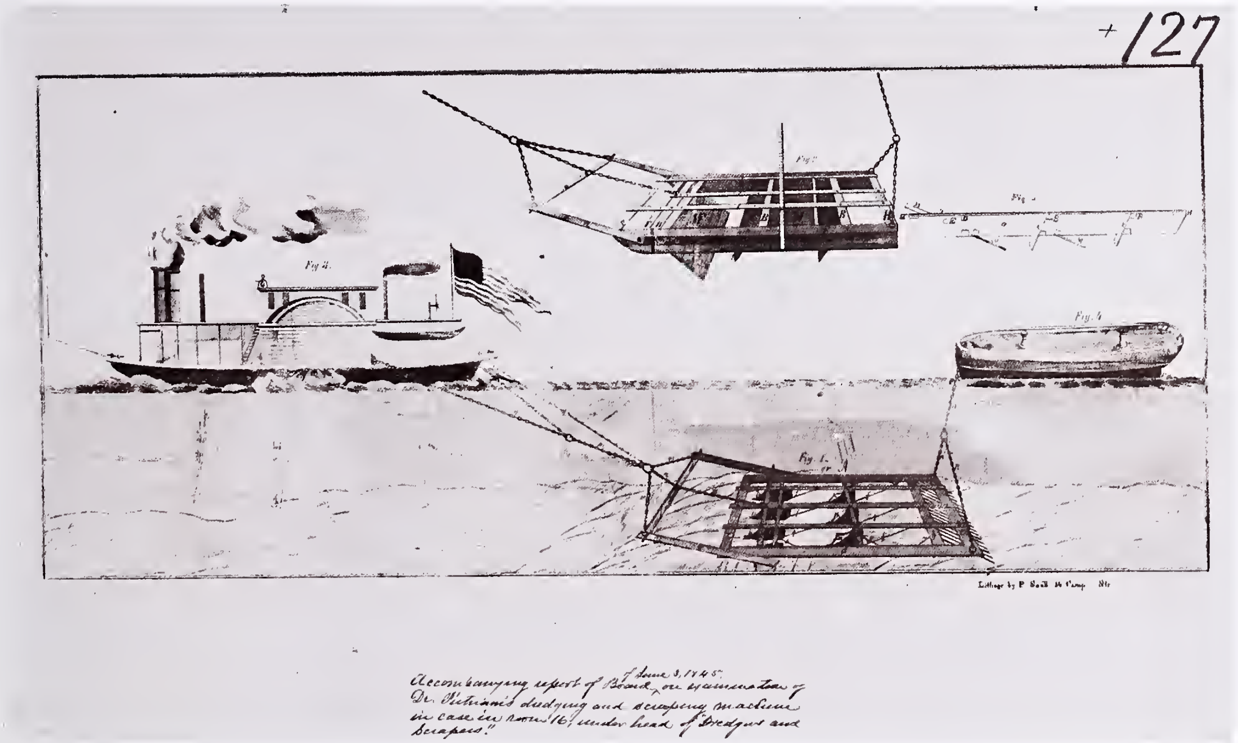
experiments with fluvial hydraulics. He studied riverflow and channel conditions at the bar, employed a work force, mounted hand-powered piledrivers on flatboats, and began construction of a wing dam. Wing dams were not built entirely across a stream, but curved out from one bank toward the river channel at about a 45-degree angle downstream to decrease the width of the channel at low water stages, increase the volume and velocity of water flowing over the bar, and thereby scour a deeper channel through the action of the river itself. During the summers of 1824 and 1825, the workers stood on the decks of the flatboats, pulled ropes to raise 500-pound weights to the top of a wooden frame, and released the ropes, allowing the weights to drop, guillotine-fashion, to the top of a wooden pile. Throughout these two summers, the workmen sweated at the ropes, raising and dropping the rams, forcing the pointed wooden piles, one by one, slowly into the riverbottom.

The Major built dams of different heights, different widths, and different lengths, and finally completed a 402-yard-long dam comprised of a double line of wooden piles connected by cross timbers and filled with brush at a shoal near Henderson, Ky. Gravel and sand washing along the riverbottom settled against the dam and made it a near permanent structure. Careful records kept of the effects of this first structure for the improvement of Ohio River navigation revealed that, at a cost of $3,778.93, the dam increased the depth of the low water channel over the shoal to four feet, quite adequate for most of the traffic then plying the river. The dam served Ohio River commerce until 1872, when it was repaired and extended. Until the late nineteenth century, the Long wing dam, known also as a spur dike, remained one of the chief methods used by the Army Engineers for increasing depths over Ohio River bars.

Snag-Clearing the Western Waterways

The Waterways Improvement Act of 1824 authorized development of the watercraft and machinery necessary to clear the thousands of water-soaked snags, often over a hundred feet long and weighing many tons, from the Ohio and Mississippi rivers.

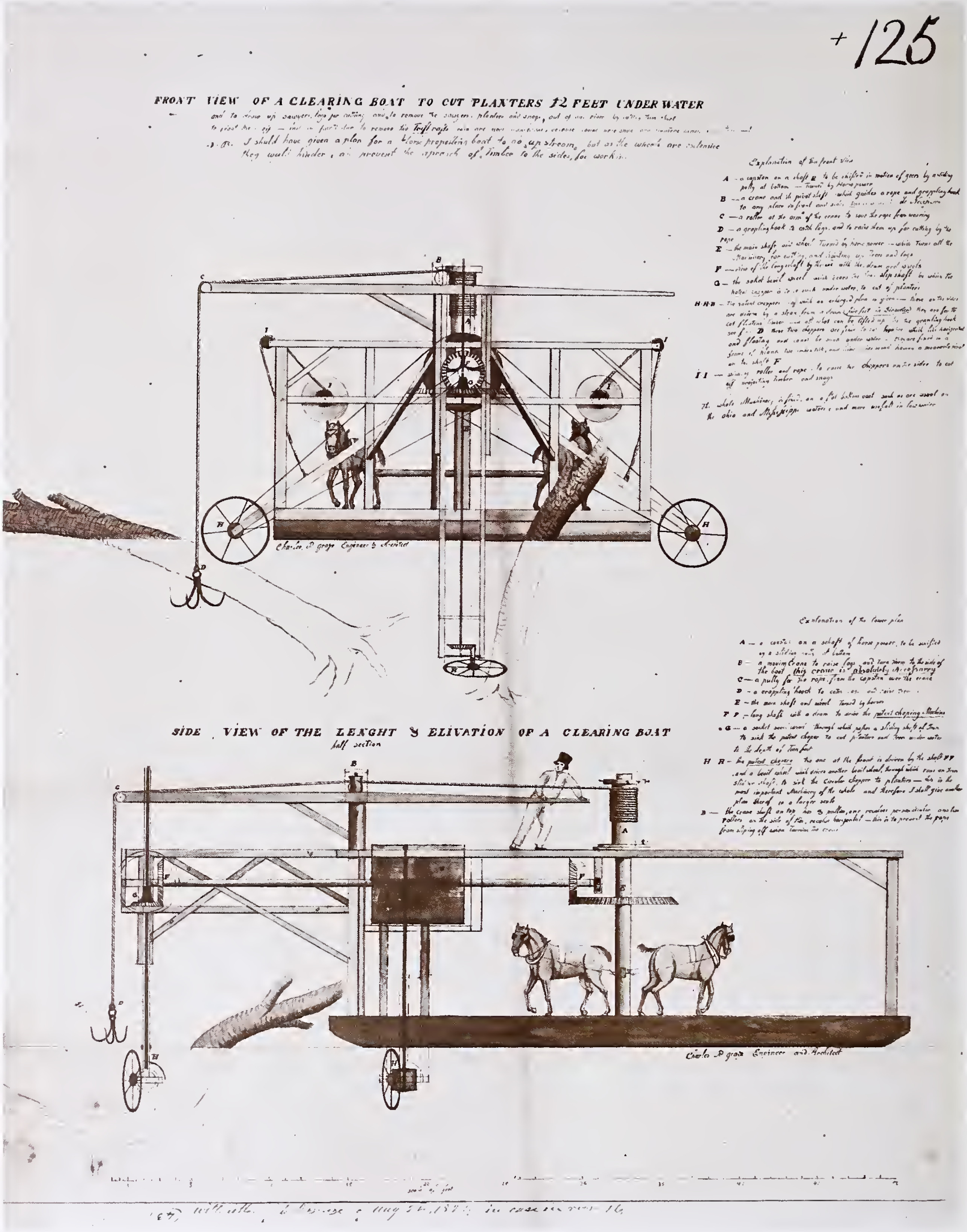
Snags could be sawed and chopped off at low water, but this left dangerous stumps that might continue to rip the bottoms out of boats. General Macomb, who had observed snags and their disastrous effects during his voyage down the Ohio with Jonathan Williams in 1801, recognized that some powerful machine to extract whole snags was needed, and, hoping to find a quick solution to the problem, he organized a public contest, of-



Accompanying report of Board of June 3, 1845, on examination of
Dr. Pitman's dredging and scraping machine
in case in room 16, under head of "Dredgers and
Scrapers."

—*National Archives*

Doctor Pitman's dredging and scraping machine plan for removal of snags and river bars.



FRONT VIEW OF A CLEARING BOAT TO CUT PLANTERS 12 FEET UNDER WATER

and to draw up sawyers, logs for cutting and to remove the sawyers, planters and snags, out of the river by cutting them short [illegible]

N. B. I should have given a plan for a horse propelling boat to go up stream, but as the wheels are extensive they would hinder, and prevent the approach of timber to the sides, for working.

Explanation of the front view

- A — a capstan on a shaft E to be shifted in motion of gears by a sliding pully at bottom — Turned by Horse power
- B — a crane and its pivot shaft which guides a rope and grappling hook to any place in front and sides [illegible]
- C — a roller at the arm of the crane to save the rope from wearing
- D — a grappling hook to catch logs, and to raise them up for cutting by the rope
- E — the main shaft and wheel Turned by horse power — which Turns all the Machinery for cutting, and [illegible] up Trees and logs
- F — view of the long shaft by the [illegible] with the drum and [illegible]
- G — the [illegible] wheel [illegible] slip shaft by which the [illegible] is [illegible] under water, to cut of planters
- H H H — The patent choppers of which an enlarged plan is given — [illegible]
- I I — [illegible] roller and rope, to raise the choppers on the sides to cut off projecting timber and snags

The whole Machinery is fixed on a flat bottom boat such as are used on the Ohio and Mississippi waters and more useful in low water

SIDE VIEW OF THE LENGHT & ELIVATION OF A CLEARING BOAT

half section

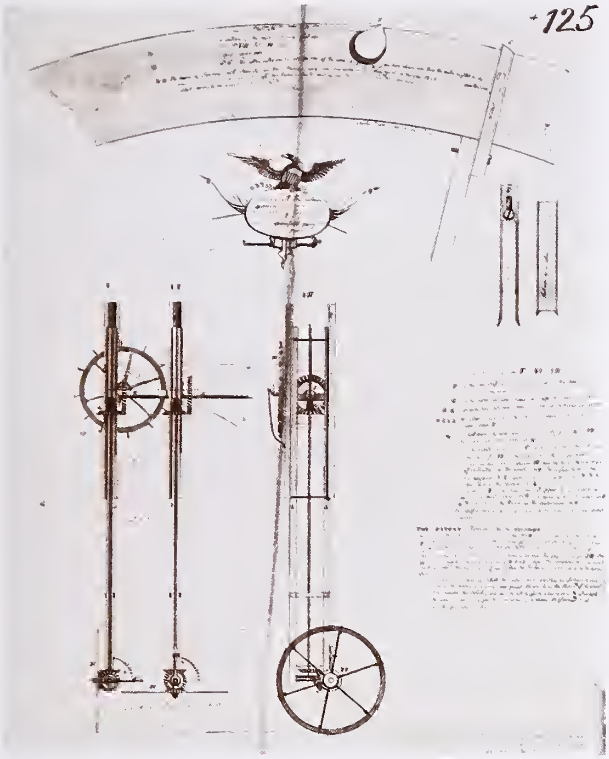
Explanation of the lower plan

- A — a capstan on a shaft of horse power, to be shifted by a sliding [illegible] at bottom
- B — a moving Crane to raise logs and turn them to the side of the boat this crane is absolutely Necessary
- C — a pully for the rope, from the capstan over the crane
- D — a grappling hook to catch logs and raise them
- E — the main shaft and wheel Turned by horses
- F F — long shaft with a drum to drive the patent choping Machine
- G — a socket [illegible] through which passes a sliding shaft of Iron to sink the patent choper to cut planters and Trees under water to the depth of Ten feet
- H H — the patent chopers the one at the front is driven by the shaft F F and a bevil wheel which drives another bevil wheel, through which runs an Iron sliding shaft, to sink the Circular chopper to planters — this is the most important Machinery of the whole and therefore I shall give another plan thereof in a larger scale
- B — the crane shaft on top has 3 rollers, one [illegible] perpendicular, one two rollers on the side of this, [illegible] horizontal — this is to prevent the rope from sliping off when Turning the crane

[illegible] Aug [illegible] in case no 16

—National Archives

Plan and detailed views of the hundreds of plans submitted in the Waterways Improvement Act of 1824 public contest for $1,000.00.



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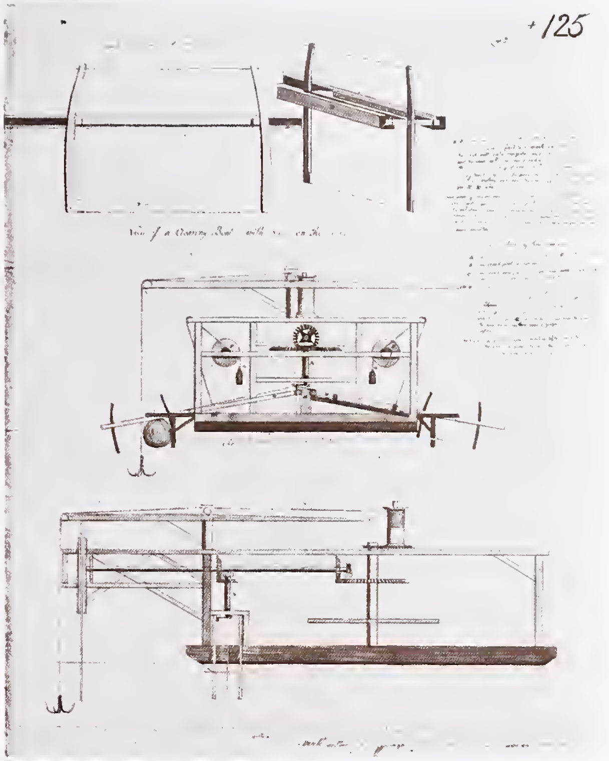


—National Archives

fering a $1,000 prize for the best machine or plan for removing snags.

Engineers, rivermen, and mechanics submitted all sorts of ingenious and weird plans for snag removal machines in 1824, for the thousand dollar prize was then a small fortune. Many of the men who entered the contest referred to disastrous encounters with snags while navigating Western rivers. One riverman wrote:

> The Amazing Quantity of Goods, of all Descriptions, and Lives, lost on these Rivers, is Frightful in the Extreme to the Human Heart, and could I cast in a Mite, to Prevent this Wonderful Devastation, it would be a lasting Source of Consolation and to the People of the United States an Unknown Savings.

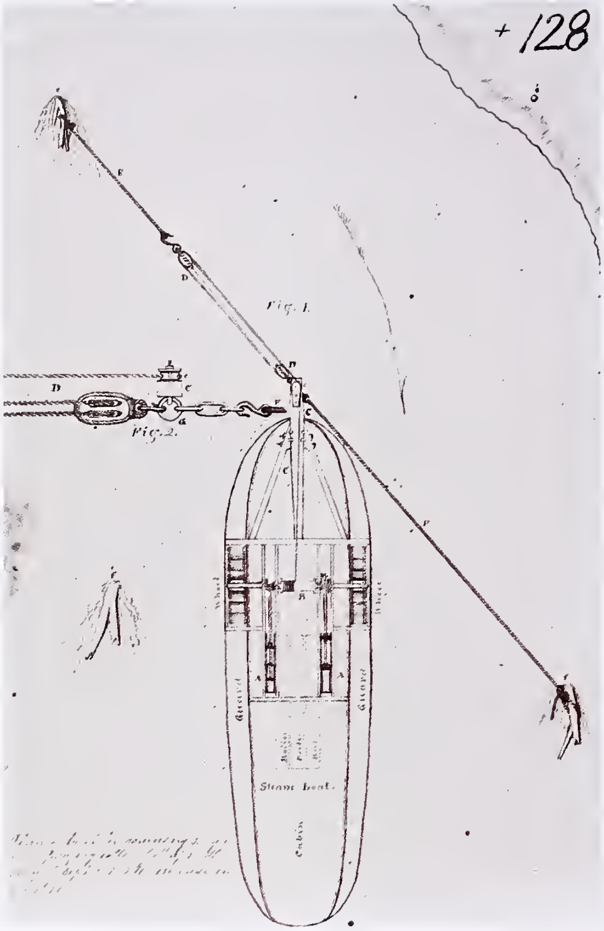
Plans for some extraordinary machines were submitted, some for blasting snags out of the channels with gunpowder, one for using a "parachute" chained to snags to open in the current and gently tug the trees from their anchorage, another for a floating wooden dam pulling plows through the riverbottom, and still another, a procedure whereby men wearing diving suits would walk the riverbed and sever snags free with a crosscut saw.

The twin-hulled ferryflats, then frequently used for river crossings, inspired many entries. Ferryflats were often propelled by horses on the deck turning a shaft geared to a paddlewheel between the two hulls. Many river mechanics thought horses could be used to turn a windlass or capstan attached to snags by chains. It would only be necessary to whip the horses to jerk the snags from the mud. Other inventors suggested the installation of steampowered windlasses on ferryflats, and still others believed that manpower alone, applied through windlasses and lever, could remove even the heaviest snags.

The $1,000 contest prize was eventually awarded to John Bruce of Vanceburg, Ky., for what he called a "machine-boat"—basically a twin-hull ferryflat with a windlass and long lever mounted on the timbers between the two hulls. An Engineer officer who observed the Bruce machine-boat in action described it as a workable device:

> Two [hulls], parallel to each other, and from eight to twelve feet apart, so as to embrace the largest trees. They are connected together by cross timbers, which support a lever of from fourteen to twenty feet in length, the fulcrum of which is two feet from the end; from this depends [hangs] an iron bar, perforated at short distances; to that is attached a pair of iron claws, shaped like those of a crab. From the end of the lever a rope passes, which leads to a windlass worked by four men. The weight of the largest trees offers but a trifling resistance to this simple machine.

The Bruce machine-boat was placed in position over a snag, the iron claw hanging from the short



—National Archives

Major Stephen H. Long's drawing for snagboat accompanying his letter of September 2, 1824.

end of the lever was hooked to the snag, and four men turning the windlass attached by rope to the long end of the lever obtained sufficient leverage to break snags free and pull them up for sawing into chunks for convenient disposal. Though the steampowered snagboat developed for the same work .in 1828 was a vast improvement over the manpowered machine-boats, use of the Bruce boats for removing snags in shallow waters continued until the Civil War.

John Bruce, a former flatboat master in the New Orleans trade, was an ardent supporter of Henry Clay, and a Whig politician who represented Vanceburg in the Kentucky legislature. His machine-boat did not differ materially from plans submitted by several other competitors for the $1,000 prize; but Bruce also proposed to enter into a contract for clearing the Ohio and Mississippi rivers of snags. He presented his plans and contract proposal to the War Department in 1824, making his bid contingent upon use of his own machine-boat. His bid was accepted by the War Department, and the Board of Engineers then decided to award the thousand dollar prize to him also.

Bruce proposed to clear the entire Ohio River and the Mississippi from St. Louis to New Orleans of snags for $60,000 a figure $140,000 lower than the bid of his nearest competitor, Samuel McKee, the famed "Warhawk" congressman from Kentucky.

The Secretary of War was astonished by the surprisingly low bid, but Bruce appeared to have a workable machine, he claimed he could do the work, was well-known in Kentucky as an honest and able man, and had recommendations from many political leaders. Henry Clay, author of the Waterways improvement Act of 1824, wrote of Bruce: "I take great pleasure in expressing my belief that entire confidence may be placed in his faithful execution of any contract that he may make with Government" for snag removal.

Some rivermen and engineers doubted Bruce could complete the snag removal project as planned, asserting the contract was a "shot in the dark" that would end by bankrupting the contractor, or wasting the appropriation. Edward Clark, a prominent civil engineer of Philadelphia, for example, declared the growing steamboat commerce on the rivers demanded something more than mere snag removal and predicted that establishing "free and safe" navigation would require work "each *succeeding* season, to repair the injuries done the navigation at each *preceeding* flood."

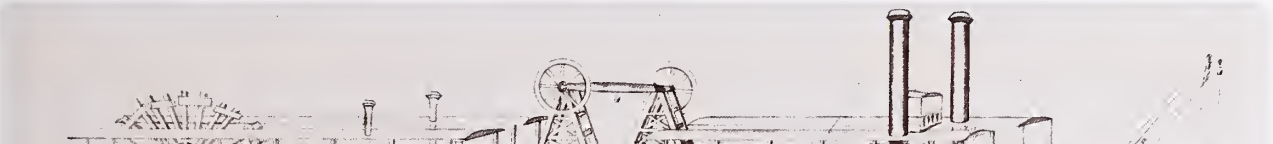
The Secretary of War, under pressure to implement quick and effective action and having no idea how many snags existed or how long it might take to extract them, told General Macomb to enter into contract with Bruce. The contract stipulated that for $60,000 Bruce would remove all snags that impeded navigation in accordance with the Waterways Improvement Act of 1824, would complete the project by January 1, 1827, and would submit his work to inspection by the Corps of Engineers.

General Macomb chose Major Samuel Babcock to supervise the Bruce contract, an unfortunate choice as it turned out, because Babcock had had no previous experience with river navigation, had never before seen the Ohio River, and had experienced problems while supervising the construction of fortifications. Major Babcock traveled to Pittsburgh in late 1824 and found that Bruce was building boats and collecting a workforce, and did not plan to begin work till spring. The Major requested leave until work began, but General Macomb rejected the request, explaining: "Western people look with great anxiety towards the accomplishment of the contract, and the Department feels great solicitude that nothing shall be wanted on its part towards carrying into effect the magnificent designs of Congress in this instance."

With eight skiffs and four machine-boats, with thirty-two men in the boats and a small force using handtools, Bruce began work on June 30, 1825, expecting to clear the Ohio and Mississippi rivers of snags in eighteen months. Because Pennsylvania had cleared the Ohio from Pittsburgh to Wheeling with state funds, Bruce rapidly worked down to Wheeling, but Major Babcock, lazily floating along behind the workboats in a bateau, observed that Bruce was clearing only the low water channel. This troubled Babcock, for more snags impeded navigation at high water than at low water stages and rivermen commonly used different channels at high water, so he asked the Chief Engineer for instructions. General Macomb bluntly told Babcock to read the contract and hold Bruce to it, but the contract was subject to two interpretations: it directed that work be performed in accordance with the Waterways Improvement Act of 1824, which called for removal of snags obstructing navigation at the *lowest stage* of water, while another phrase in the contract required removal of all snags "which impede navigation." Bruce doubtless showed Babcock that both the Act of 1824 and the advertisement for bids called for snag clearance from the low water channel, and the Major made the mistake of accepting this interpretation.

When Bruce and his men completed the work to Maysville in September, the project was temporarily interrupted because some of the men celebrated too enthusiastically and were "made prisoner" by citizens of Maysville, but work resumed and Bruce reached Louisville in November. By November, Western rivermen were in an uproar and angrily complained to Congress about Bruce's work. Henry Clay received a letter castigating Bruce and Babcock for negligence, listing snags left in the Ohio, pointing out that work was limited to the low water channel, and urging removal of Major Babcock. Rivermen of Maysville and Louisville sent hot protests to Congress, personally complained to Bruce, and told Major Babcock to employ a river pilot as assistant project inspector. The Ohio congressional delegation made formal protest to the War Department, demanding full investigation.

General Macomb rushed another Engineer officer to the Ohio, without informing Major Babcock, and told the officer the Bruce contract required clearing the whole river of snags and that Bruce clearly understood that it did. When the



—*National Archives*

Roaring Jack Russell's plan for snagboat.

officer reported that the condition of the river showed the "greatest neglect" on the part of the contractor, General Macomb suspended the contract pending further investigation, arrested Major Babcock, and ordered Major Long, then building the experimental wing dam, to take charge of the snagging project.

A general court-martial tried Major Babcock on charges of neglect of duty, disobedience of orders, and making false reports, found him guilty on all charges, and sentenced him to dismissal from the service. President John Quincy Adams personally reviewed the evidence in the case and concluded that Major Babcock had conducted his duties to the best of his ability, that errors resulted chiefly from the novelty of the project, and that Babcock's great mistake had been in accepting the contract interpretation of John Bruce. The President therefore remitted the sentence and restored Major Babcock to the service. Senator William Henry Harrison of Ohio came to a somewhat similar conclusion. He believed the problems with the Bruce contract resulted from a "mis-construction of the contract, which had been couched in the words of the law itself."

When Bruce was allowed to resume work in 1826 the expert services of Major Long were required on other projects, and General Macomb shrewdly appointed Samuel McKee, who had been the chief competitor of Bruce for the contract, as project inspector. Work slowed because McKee required Bruce to clear the river from bank to bank, and because McKee died suddenly on the job in October 1826, again leaving the project without an inspector. General Macomb began a careful search for a man with great experience with river navigation, a man respected by river captains and shippers, a man who knew the river like the palm of his hand. Major Long and most Ohio River steamboatmen knew such a man and urged his appointment to the job, and on December 10, 1826, General Macomb appointed the most famous steamboat builder and master of the era, Captain Henry M. Shreve, as Superintendent of Western River Improvements.

Captain Shreve inspected the work and reported that John Bruce and his machine-boats could never satisfactorily complete the project, and General Macomb forfeited the Bruce contract on April 9, 1827. Bruce, who had been paid $18,563.93 for work completed, employed attorneys and brought his case to the attention of Congress, basing his petition not on misinterpretation of the contract, but on the failure of the Corps to furnish adequate supervision for the project. Congress awarded Bruce $6,240.63 in 1834, but rejected his claims for additional compensation. A House committee, after full investigation of the Bruce contract, reported:

> The undertaking was new. Persons possessing the requisite practical knowledge of the navigation and the obstructions to the same, of those rivers, could not be, or were not employed at the commencement of the work. The difficulty of removing obstructions which were fastened in the bed of the river, 20, 30, and 40 feet below the surface of the water, was not easily to be overcome. The agency of some machinery, not before in use, for the improvement of our water courses, was deemed indispensable. Much of the time, and a great portion of the money was expended in the necessary experiments and preparation to commence the work.

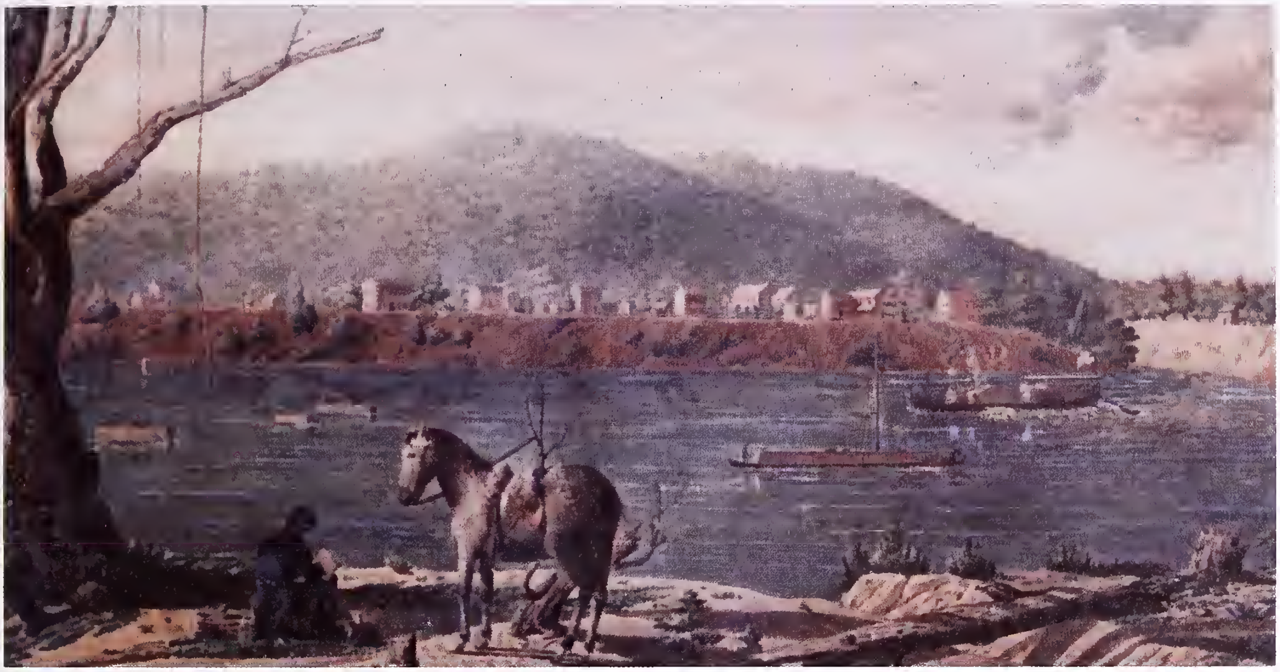
John Bruce was bankrupted; Major Babcock resigned from the service and died less than a year later; and dozens of boats on the Ohio and Mississippi were still snagging and sinking. A harsh but effective lesson for Congress and the Corps of Engineers!

It was many years before the Corps again entered into a contract for snag removal. It used its own boats and its own men for such work. And thereafter the Corps employed only the most experienced rivermen and waterways engineers to be had. The impact of the lessons of the Bruce contract was clearly reflected in the River and Harbor Act of 1827, the first of a series of annual appropriations for the Ohio and Mississippi River project, which required the removal of all snags which impeded navigation at any navigable stage and directed that "practical" agents supervise the work.

From 1827 until the Civil War, the history of the efforts of the Army Engineers to improve the Ohio River for steamboat navigation and waterborne commerce was very largely the story of two colorful men: Captain Henry M. Shreve, a vitriolic rough-and-tumble steamboat captain, and Major Stephen H. Long, a cool, precise Engineer officer. These men, who perhaps together contributed more to the development of the unique Western river steamboat than any other pioneer marine engineers, were responsible for the improvement of the inland rivers through the Office of Western River Improvement, as it was known, until the fratricidal Civil War tore the nation apart.

Chapter III

Ohio River Engineering, 1827–1857



Artist: Felex Achille de St. Aulaire, Collection of Herman P. Dean

Painting of the town of Guyandotte, Virginia on the Ohio River about 1821.

Gaudy, gingerbread trimmed steamboat palaces regularly roiling the waters of the Ohio River and its major tributaries had more impact on the economic and social development of the region than any other technological innovation of the early nineteenth century. Less than forty years after the little *New Orleans* made the pioneer voyage on the inland rivers in 1811, Western river steamboat tonnage exceeded the combined steamboat and steamship tonnage of the rest of the world.

Nearly 6,000 steamboats were built along the inland rivers between 1820 and 1880, and, from first to last, about three-fourths were built in the Ohio valley. The steamboat construction boom gave an enormous boost to Ohio valley industrial development, and the speedy, economical transportation the steamboats furnished accelerated commercial growth and ended the frontier isolation of the region.

Timothy Flint, who descended the Ohio in a flatboat in 1815 and returned in a steamboat in 1826, wrote:

> I had remarked, as soon as we began to pass the high lands on the Ohio, the wonderful change, which ten years had wrought in that region. The log-houses were gone, and replaced by houses of brick. The orchards, which were just planted when I descended the Ohio, had become thrifty trees of considerable size, and were now white with blossoms. Passing steamboats, thriving villages, bustle and business had taken place of the solitude and stillness of the same places at the former period.

Captain William Tell Poussin, Corps of Engineers, thought the splendor and the powerful engines of the Western river steamboats somehow embodied the aggressive spirit of western Americans. Foreigners were apprehensive, Poussin said, when they saw magnificent three-decked steamboats with 1,200 passengers zipping past each other in opposite directions, but the "cool and tranquil" Americans, calmly leaning against the guardrails and munching cigars, were undismayed.

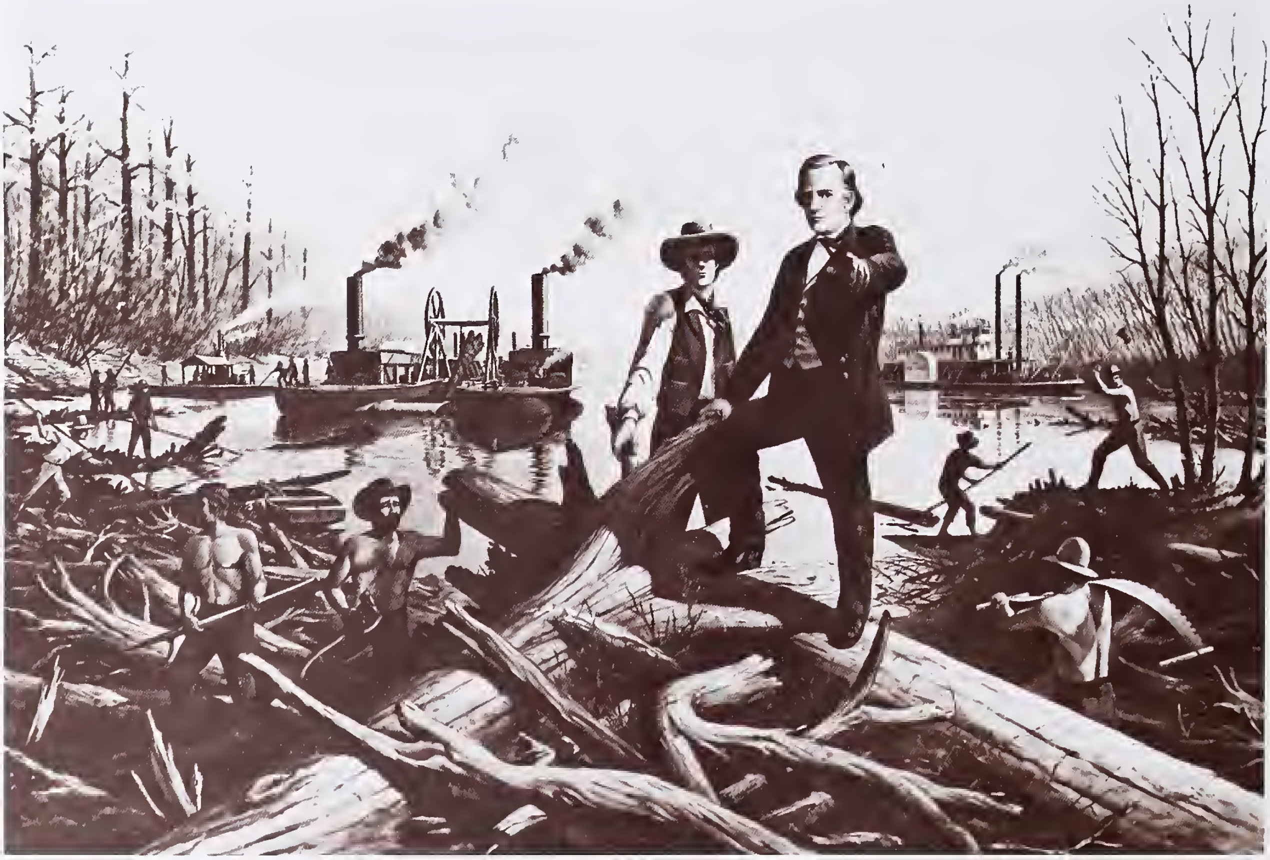
The success of the Western river steamboats and their impact on the Ohio valley had been largely responsible for the enactment of the first Waterways Improvement Act, in 1824. Improving waterway navigation for the benefit of steamboat commerce was to be the principal function of Army Engineers in the Ohio valley until the Civil War.

The Shreve Regime

When the Bruce snagging contract was terminated in 1827, General Alexander Macomb, Chief of the Corps of Engineers, arranged with riverman Henry Shreve to employ laborers and continue clearing snags from the Ohio and Mississippi. Captain Shreve sent a crew of workmen down the Ohio River to remove snags missed by Bruce, and took another crew to the lower Ohio and the Mississippi. But he found the work "extremely laborious and somewhat hazardous." Each time a machine-boat successfully pulled a snag, the current sent the boat whirling downriver, and the workmen lost much time in repositioning the boat over another snag. The Captain, with more experience with steamboats than any other man in the West, naturally thought of using steamboats for the work.

Shreve had begun study of methods of using steamboat power for snag removal in 1824, and in 1827 he submitted plans to the War Department for a steampowered snagboat, urging the Department to approve the construction and testing of such a boat. He estimated the cost of an experimental snagboat at $20,000; the War Department, with the unfortunate experiences of the contest and contract of 1824 fresh in mind, was reluctant to chance wasting more of the limited funds Congress had provided. Shreve, irascible, impatient, indomitable, finally won approval for building an experimental prototype of his snagboat in June 1828.

When the first steam snagboat, the *Heliopolis*, slid down the ways at New Albany, in early 1829, and plopped into the water like two fat ducks in a pond, it was greeted with jeers, for it appeared cumbersome and unwieldy. The *Heliopolis* was twin-hulled, like the Bruce machine-boats, with giant windlasses mounted on timbers between the hulls. Several engineers who entered the 1824 contest had submitted plans for using steampowered twin-boats, with steam engines operating the windlasses and snag machinery, but Shreve added a huge iron-plated timber, called the



Copyright 1970, the R.W. Norton Art Gallery, Shreveport, La.

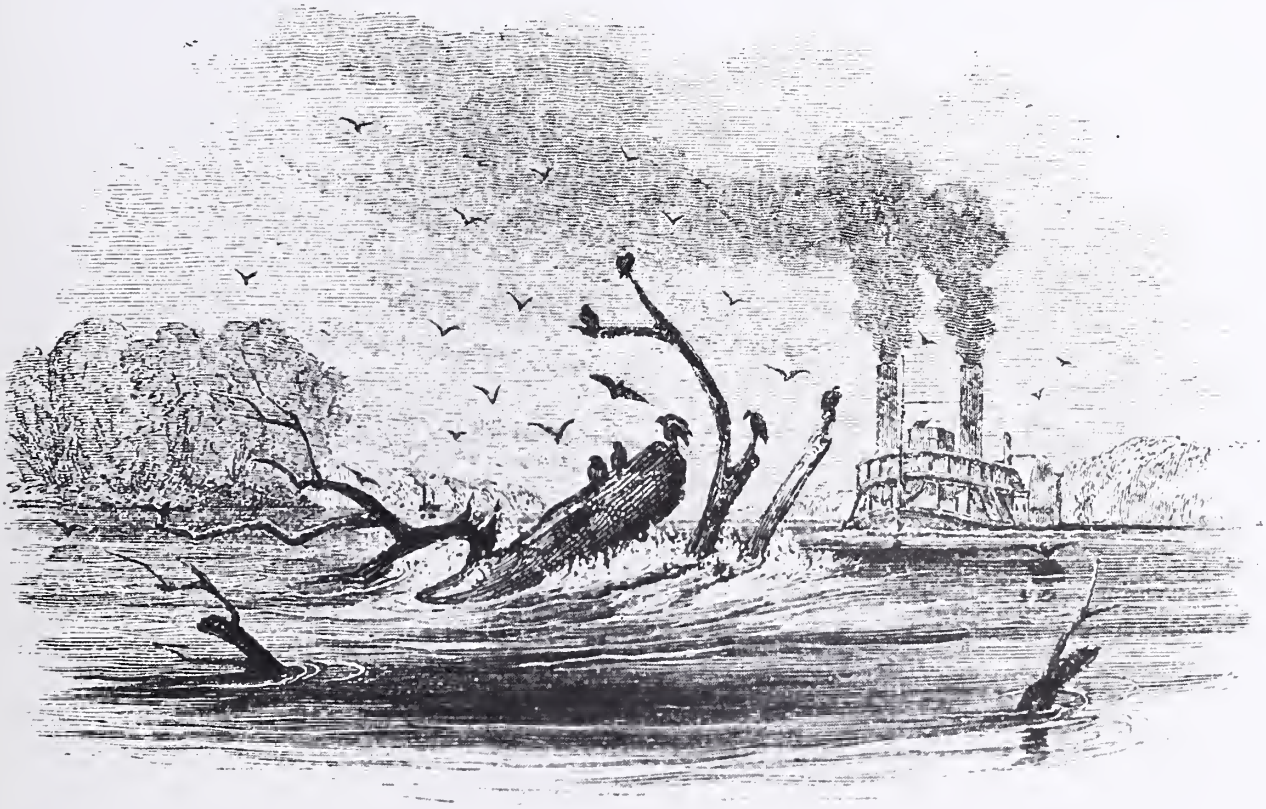
Captain Henry M. Shreve clearing the great raft from the Red River from 1833 to 1838.

"snag-beam," between the two hulls at the waterline. His plan called for the *Heliopolis* to get up full steam and, running with the current, ram into snags head on, smashing them with the snagbeam and jolting them loose from the riverbed or breaking them off. This, Shreve reasoned, would combine the power of the steam engines, the momentum of the boat, and the force of the current, and snap any snag in the stream.

In August 1829 Captain Shreve steamed the ungainly snagboat to a snag-infested riverbend for tests, and an amused crowd of steamboatmen gathered to watch. Laughter rippled across the water at the sight of the cumbersome craft, for cynics were sure the snagboat was another worthless government boondoggle. But the chuckles ceased when the boat smashed into the first snag at full speed, vibrated for an instant, and moved ahead, toppling the monstrous tree into the river. The crew of the *Heliopolis* cheered, all engines stopped, and chains were attached to the snag. Slowly the giant windlasses turned, easing the heavy planter up between the hulls onto rollers, where the crewmen sawed it into chunks. One by one, crash after resounding crash, the *Heliopolis* bucked and butted the snags over, retrieved them, and methodically cleared the river. Simple of construction, easy in application, no machine could surpass the Shreve snagboat in removing snags, one inspecting Engineer officer said. "Through the agency of this machine," he declared, "the largest snags and logs are extracted with ease, many of which, without its intervention, could never have been removed." Captain Shreve's triumph was complete.

The startling efficiency of the *Heliopolis* was marked by Ohio and Mississippi river navigators and shippers, who demanded that Congress appropriate funds for building more snagboats. Congress responded with funds sufficient to build five more of "Uncle Sam's Toothpullers," as rivermen called them, before 1838. Captain Shreve gave each boat a ringing name—the *Archimedes*, the *Eradicator*—and dispatched them to roam the inland rivers in search of hull-busting snags, jerking them out of the streams by the thousands. On a single two-mile stretch of the Ohio, enough snags were pulled from the river, cut, stacked, and burned, to equal 1,200 cords of firewood.

During the five years prior to construction of



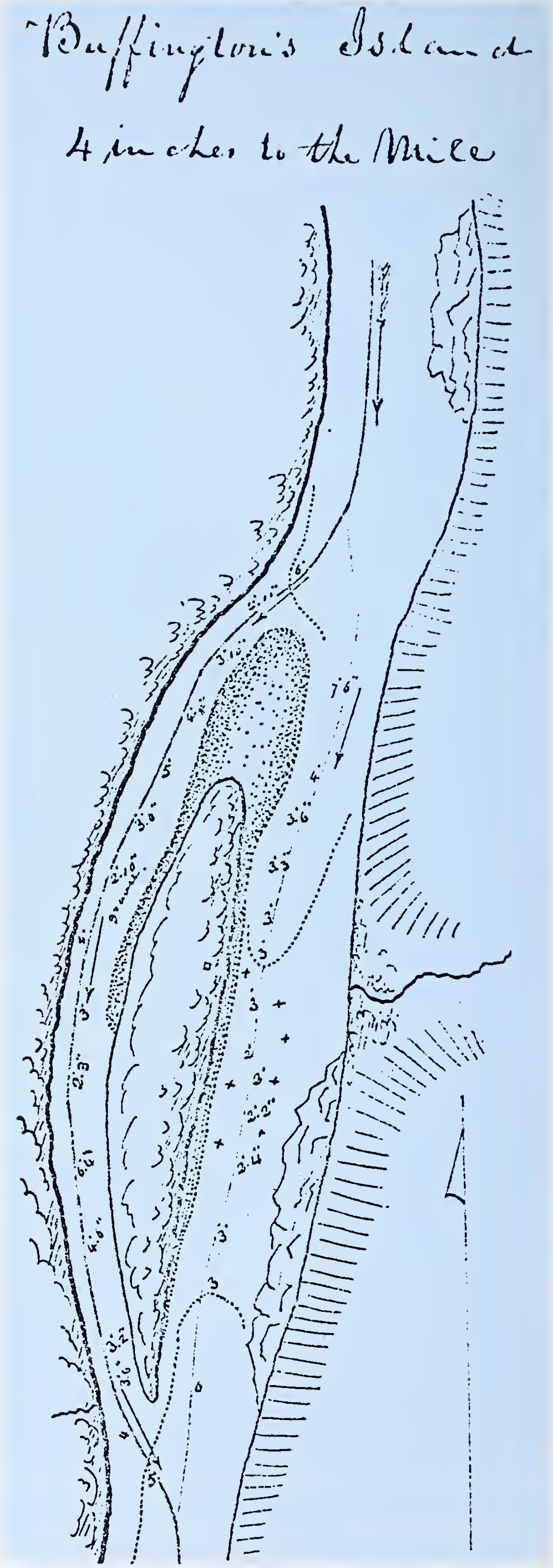
Typical of snags that infested the western rivers.

the *Heliopolis,* cargoes valued at $1,360,000 were lost in boats which wrecked on snags; in the next five years, these losses were reduced by 75 percent, and, as a result, marine insurance rates dropped 50 to 75 percent. Captain Richard Delafield of the Corps of Engineers inspected Shreve's work in 1833 and reported that risks to navigation had been greatly reduced and that steamboats had begun to run the rivers at night. He predicted the time was not far distant when snags would become merely an unpleasant memory.

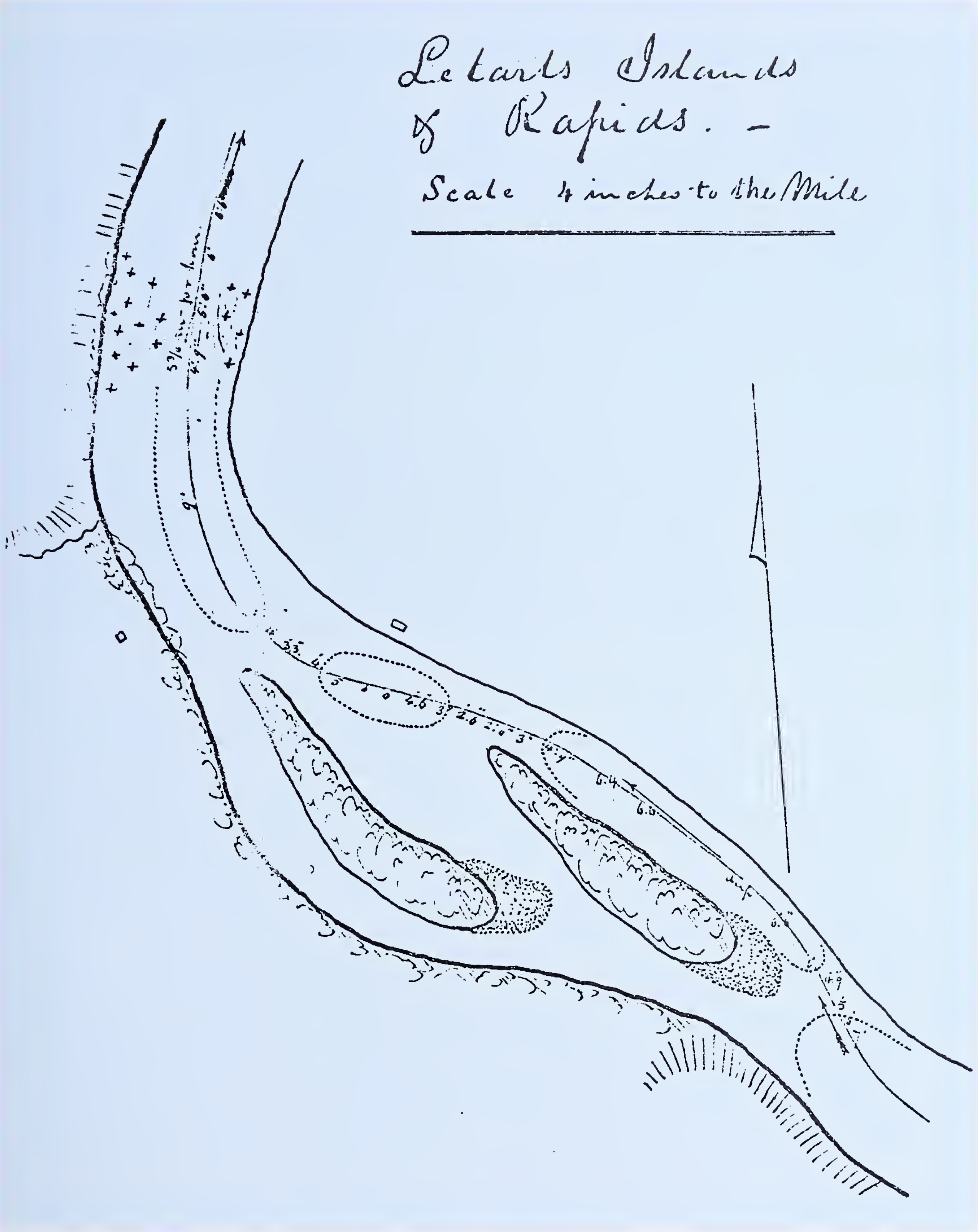
The Ohio River navigation project was not limited to snag removal, for Congress also provided funds to build more of the Long wing dams at river bars, to close secondary channels behind islands, and to blast channels through some of the more obstructive shoals. Shreve directed the work of blasting crews who removed huge boulders from the channel and cut through ledges by standing in the river at low water, pounding steel drills into the rock with sledgehammers, inserting canisters of black powder, and detonating the charges—highly dangerous, but effective work. Shreve also built several Long wing dams to increase depths over bars and closed secondary channels behind islands with low stone dams. Built of random stone from nearby quarries, these dams became nearly permanent fixtures on the Ohio—one was still in place in 1971 near Smithland, Ky. and functioning as Captain Shreve had planned.

Supervising rock excavation and dam construction at scattered worksites along the Ohio and directing the farflung operations of snagboats on the Ohio and Mississippi rivers and several tributaries presented Captain Shreve with many problems. He thought his worst problem was the voluminous paperwork and strict accountkeeping necessary in government service, for he was a man of action and had been ill-prepared for government project administration by his rough experience as a keelboat and steamboat master. He continually complained about recordkeeping, once declaring angrily it was quite impossible to keep up with the paperwork while incessantly traveling from construction sites to snagboats and back. He also violated War Department protocol on occasion by taking his problems directly to members of Congress, but the Chief of the Corps of Engineers did not object, so long as Shreve's work on the rivers was satisfactory.

The chief criticism of the work of Captain Shreve came from his fellow steamboatmen and river shippers of the upper and central Ohio valley. They faulted not the quality of his work, but the fact that not enough of it was done above the Falls of the Ohio. Appropriations were limited and had to be expended over the entire course of the Ohio and Mississippi rivers; and rivermen at



—National Archives


Letarts Islands
& Rapids. –
Scale 4 inches to the Mile
5½ mi per hour
4.9
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—National Archives

Drawings of Lieutenant George Dutton's 1835 Ohio River survey.

Cincinnati, Maysville, Guyandotte, Marietta, Wheeling, and Pittsburgh were convinced that not enough was being done to help them. In response to this criticism, Congress divided the Ohio River navigation project in 1835, making separate appropriations for the sections above and below the Falls.

Upper Ohio Project

The Chief Engineer reduced the duties of Captain Shreve by assigning work on the upper section of the Ohio to Lieutenant George Dutton of the Corps. In early 1835, Lieutenant Dutton acquired a copy of the Joint State Commission survey of 1819 and descended the river in a skiff to update the maps and plan the project. Dutton found the greatest obstruction to navigation in his section of the river was the old flatboatman's nemesis, Letart Falls, where rocks littered the channel and where the current was so swift that even light steamboats could not ascend without cordelling or warping in keelboat fashion.

Dutton was especially struck by the large numbers of sandbars obstructing navigation below Guyandotte, concluding that the hydrology of the Ohio River changed at the mouth of the Guyandotte River. Above, the slope was steeper, the channel rockier; below, the river was wider and its current slower. Because the upper river section had so little flow during dry seasons, Dutton believed that only the construction of locks and dams to establish slackwater navigation would adequately improve the river for year-round use. But funds were limited and he planned an open-channel or "sluice" navigation project to deepen the channel at bars by constructing wing dams and closing secondary channels, while again clearing the river of snags.

Shortly after Dutton submitted his report, he was reassigned to supervision of construction on the National Road in Ohio, and Lieutenant John Sanders of the Corps was given charge of the upper Ohio project. Young Sanders, a short, stout, phlegmatic fellow, did not look the part, but his friends thought him an engineering genius. Perhaps he was—he invented a steam piledriver and a mechanical concrete mixer, and devised mathematical formulas for rational calculation of proper pile bearings and concrete mixtures; and his intelligence was confirmed by his marriage to the beautiful daughter of the Secretary of War.

During the winter of 1835-36; Sanders built Bruce machine-boats, keelboats, and scows and dispatched them to clear the Ohio of snags, organized five work parties of sixty men each to travel the riverbanks cutting and burning trees threatening to fall into the river and become snags, and began construction of low stone dams at a few of the more obstructive bars and shoals.

The Lieutenant expected the removal of snags and potential snags and the construction of dams at shoals and behind islands to establish a clear channel with a minimum depth of thirty inches—a thirty-inch channel would permit boats of 100 tons to run at low water stages—but he realized soon after work was begun that the Bruce machine-boats could not satisfactorily clear the channels and that not enough was known about the hydrology of the Ohio and the condition of its riverbed to achieve a thirty-inch depth.

To handle the snags, Sanders arranged for construction of a light-draft version of the Shreve steam snagboat, which he named the *Henry M. Shreve*, and put into operation on the upper river in 1838. In the same year, he employed Charles A. Fuller, a former classmate at West Point, to assist in completing a detailed topographic and hydrographic survey of the upper Ohio in order that enough might be learned about river conditions to permit construction of dams on a rational basis, rather than by trial and error.

The maps of the Ohio drawn by Thomas Hutchins, Andrew Ellicott, and the Joint State Commission of 1819 had shown the course of the river, with a few line maps of obstructions, but these were too sketchy for use in selecting proper sites for navigation dams. Sanders was determined to learn precise depths, widths, and foundation conditions, so in the summer of 1838 he and Fuller began at the head of the Ohio and worked downstream, measuring precise distances and depths, interviewing rivermen, walking the banks, and wading back and forth across the river.

Wading across the Ohio might seem improbable, but 1838 was the year in which the Ohio was at its lowest level of record; there was less than a foot of water over some of its bars. Steamboats stopped running and took harbor on July 20 and there they remained until November 8, and for much of the time not even keelboats could navigate the Ohio.

Sanders thus described the far-reaching effects of this navigational hiatus: "The inconvenience and loss arising from an interrupted navigation of the river has been felt throughout the Union. Large quantities of merchandise destined west, were detained for want of river transportation at Pittsburgh, Wheeling, and Portsmouth, and the produce of the country at the points where grown. Travellers had to resort to an expensive land transportation, or await the rising of the river."

But 1838 was an excellent year to survey the river, for much of the riverbottom was exposed, and Sanders and Fuller completed their survey down to Letart Falls (Mile 234). The Sanders-Fuller survey was so well done that the maps were used by the Corps until 1911.

"Hi" Carpenter Collection

Low water on the Ohio River in 1908. Conditions must have been like this during the 1838 Sanders-Fuller survey.

The river survey had just been completed when all work on inland river navigation projects was stopped. President Andrew Jackson was noted for his opposition to internal improvements—federal road and canal construction—but he had continued the waterways improvement policy established by Congress during the administration of John Quincy Adams. Congress had annually appropriated funds for inland river improvements from 1827 to 1838, and President Jackson had approved most of the appropriations. President Jackson was succeeded by Martin Van Buren in 1837, and Van Buren, opposed to both road and waterway projects at federal expense and faced with the first major economic depression of national history, reversed the waterways policy and stopped appropriations, leaving all river projects in a half-finished condition.

Lieutenant Sanders sold the Engineer boats and tools at public auction in 1839 and was reassigned to a military construction project; Fuller took a job with the Ohio State Board of Public Works; and Henry M. Shreve moored his snagboats at the St. Louis harbor, where they rotted for four years.

In the "log cabin" presidential election of 1840, Whig candidate William Henry "Tippecanoe" Harrison, and "Tyler too," defeated Van Buren and the Democrats. President John Tyler, of Virginia, who took office at the death of Harrison in 1841, had a reputation as a states' rights advocate, but he approved of work for the benefit of Ohio and Mississippi river navigation, so important, he said, to national prosperity and defense.

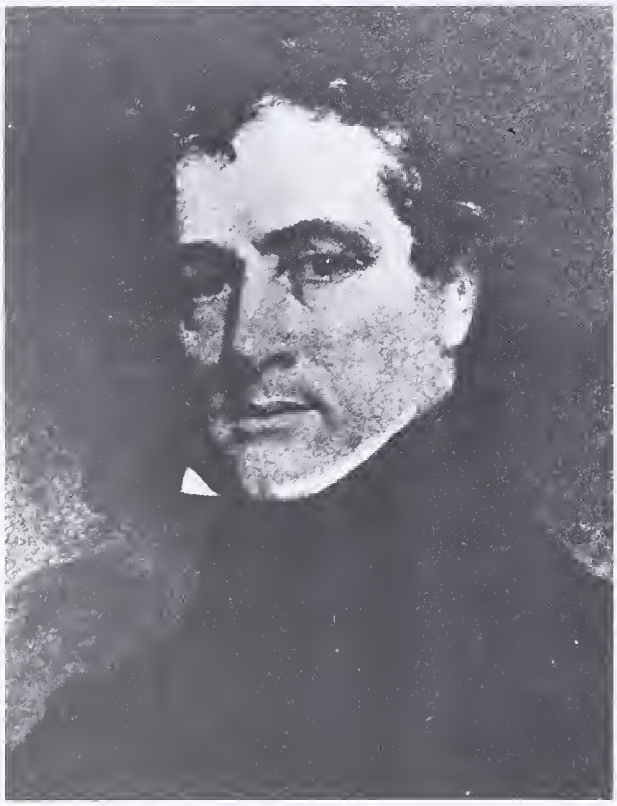
President Tyler was supported in the Ohio valley by a convention of rivermen meeting at Cincinnati in 1842 to publicize the disastrous consequences of suspension of work on the rivers. In a petition to Congress, members of the river convention declared that snags had accumulated swiftly since cessation of snagging operations and that 138 steamboats had wrecked on the rivers from 1839 to 1842, with losses to shippers estimated at a million dollars annually. With renewed public support, and the approval of President Tyler, Congress made a new appropriation for the Ohio-Mississippi waterway project in 1842, and provided more funds for the work in 1843 and 1844.

Another Riverman Placed in Command

Captain Henry Shreve had admired Andrew Jackson since he first met the General at New

Orleans in 1814, and he had publicly supported Jackson in the political arena. When the Whig administration took office in 1841, Shreve was dismissed as supervisor of snagboat operations, and a steamboat captain who also was an ardent Whig, was appointed to the post. A Kentucky newspaper editor did not approve of the dismissal of Shreve for political reasons, but thought the steamboatman who replaced Shreve was an excellent choice, because he could "knock down six of the best men in his employment at any time."

The new snagboat superintendent was Captain John W. "Roaring Jack" Russell of Kentucky, a giant of a man who had become famous for his humor and his exploits as a steamboat captain. Like Shreve, Russell had learned the rivers early in life as a keelboatman and moved up to steamboats, and the wiry muscles he developed poling keelboats stood him in good stead. He once floored the pirate Jean Lafitte in a New Orleans brawl, and, in the so-called Second Battle of New Orleans, Russell and his boatmen fought Lafitte and his pirates to a standstill until the Louisiana militia broke it up. When one of his steamboat passengers was robbed at notorious Natchez-under-the-Hill, "Roaring Jack" retrieved the money by attaching a cable from his steamboat to one of the rickety houses at riverside and towing it into the Mississippi, threatening to pull in the entire town if the passenger's money was not returned. Such exploits won Russell acclaim as the most "noble, generous, and brave-hearted" man on the rowdy rivers.



Kentucky State Historical Society Library, Frankfort, Kentucky

Captain John William Russell replaced Henry Shreve as supervisor of snagboat operations in 1841.

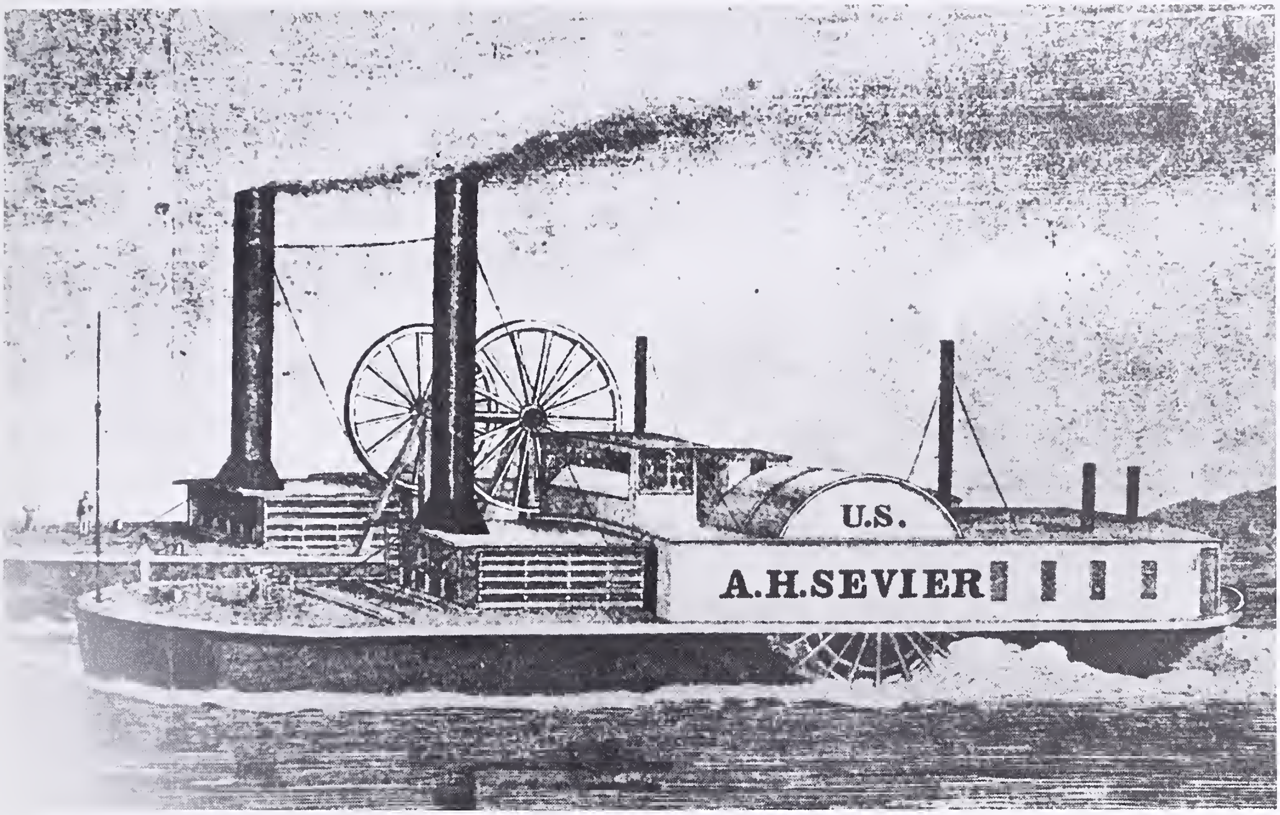
When "Roaring Jack" went to St. Louis in 1842 to put the snagboat fleet back in action, Captain Shreve refused to permit it and slapped a court injunction on the Kentucky giant, for Shreve had acquired a patent on the snagboat design in 1838. Russell returned to the Ohio valley and began construction of a new fleet of snagboats, while the Corps of Engineers studied the history of the development of snagboats. The Corps found Shreve's patent valid and agreed to reimburse him, but the question of how much the invention was worth led to extended litigation. Shreve retired from the rivers, and, somewhat ironically, invested in railroads; just before his death in 1851 he organized a company which became part of the Missouri Pacific Railroad. Thirty years after Captain Shreve died, Congress awarded his estate $50,000 for use of the patented snagboat.

Putting an Engineer in Charge

The Engineer Department was reorganized in 1841, with the Corps of Engineers, which was responsible for construction of seacoast fortifications, assigned supervision of navigation projects at coastal harbors, and the Corps of Topographical Engineers, the Army's surveying and mapping agency, assigned charge of inland river projects. The Chief of Topographical Engineers decided to eliminate some of the political influence on appointments to inland river projects by placing Engineer officers in charge.

Colonel Stephen H. Long, who had been surveying and planning navigation projects and some of the first railroads in the nation since he left the Ohio River project in 1826, was made new chief of inland river projects in 1843, with Captain Russell reduced to supervisor of snagboat construction. As might be expected, Colonel Long and "Roaring Jack" did not get along well at first, but a mutual respect developed and Long eventually landed in hot water because of his efforts to defend the Captain against dismissal for political reasons.

Long and Russell repaired the old Shreve boats *Heliopolis* and *Archimedes*, returned them to snagging duty, and built the new snagboats *Samson*, *Sevier*, *Hercules*, *Gopher*, and *Dragon*.



—National Archives

One of the new snagboats built by Long and Russell after Long took charge of the snagboat fleet.

Three of the new toothpullers were heavy twin-hull boats on the Shreve patent; the *Gopher* and *Dragon* were light-draft single-hull boats designed by Russell with A-frame derricks, replacing windlasses, mounted on their prows. In 1843 and 1844, with seven snagboats in action, the inland rivers were quickly cleared of the most hazardous snags, but new snags formed after every flood. Service on Uncle Sam's toothpullers was not a picnic—the crews were decimated by accidental drowning and maimed in the complex system of ropes, chains, and pulleys. Disease also found its way aboard ship at times, and snagboats sometimes limped into port with reduced crews—impaired by disease, or by desertions in fear of disease. Service aboard the Western river snagboats was, said the Chief of the Corps, equivalent to Army combat duty.

Colonel Long hired the toughest river captains to be had to maintain order on the boats and instituted severe penalties for insubordination. In explaining his reasons for maintaining rigid shipboard discipline, the Colonel incidentally revealed his acerbic view of human nature. He said penalties for improper behavior were much more effective than rewards for achievement, because no matter how "worthless & inefficient any individual may prove to be, he is generally unwilling to admit, that his services are not equally as valuable & praiseworthy as those of the most industrious & faithful." A system of rewards, rather than penalties, would only create dissension.

Congress again made separate appropriation for the improvement of the Ohio River above the Falls of the Ohio in 1842; the Chief of Topographical Engineers accordingly ordered Captain George W. Hughes of the Corps to examine and report on the condition of the upper river, describe what repairs were required at the dams built by John Sanders, and report a plan for renewed operations.

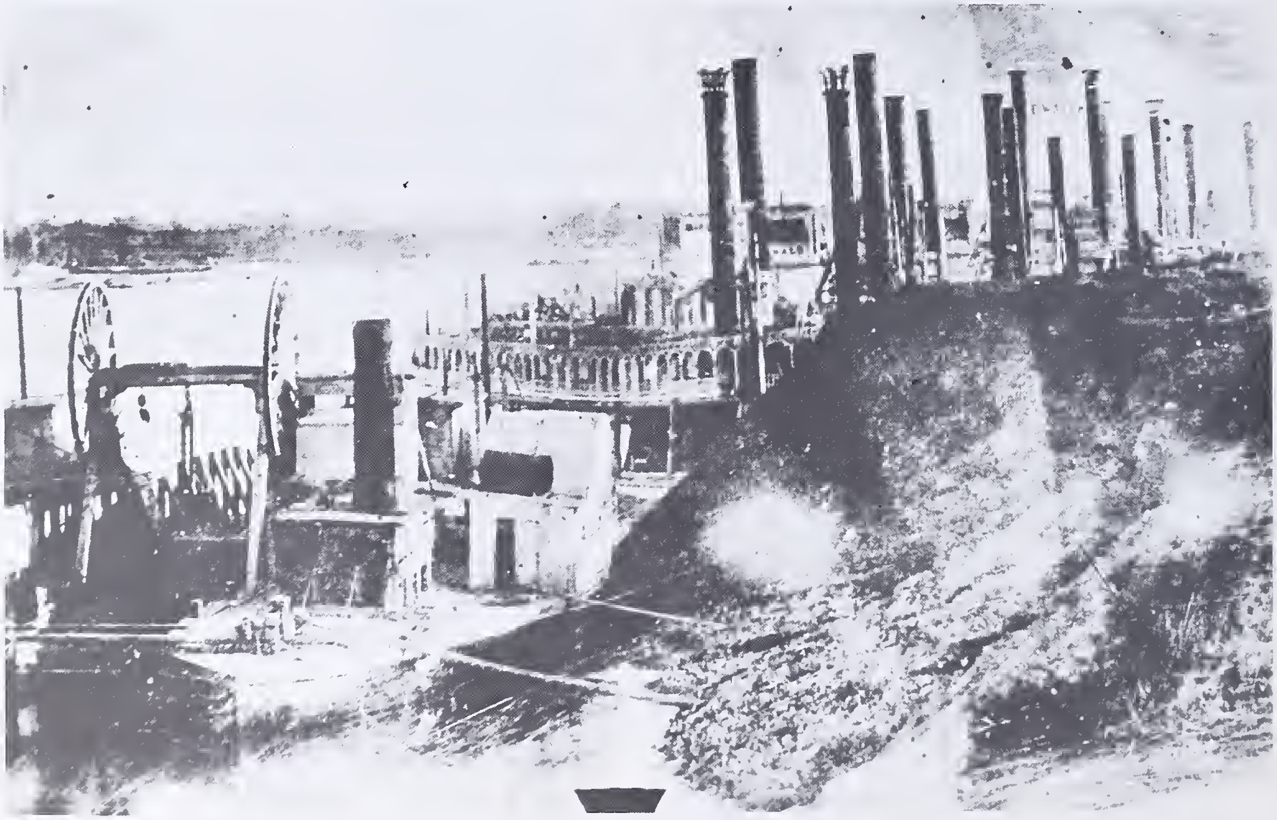
Captain Hughes acquired a copy of the Sanders-Fuller survey of 1838 and set out downriver from Pittsburgh in a two-oared skiff in late 1842. He found the Ohio River again "greatly embarrassed" with snags and drift, the Sanders dams partially breached by men who stole the stone for private use, and very serious navigation hazards at Letart Falls and the mouth of Guyandotte River. At Letart Falls, steamboats were paying $5 each for teams of oxen to tow them up the swift current, and just below the mouth of the Guyandotte sand and gravel bars so obstructed navigation that Hughes saw three steamboats—

the *Athenian*, *Lighter*, and *Kentucky*—sunk in the channel and several others grounded and trying to get free. Captain Hughes reported the best way to improve Ohio River navigation would be to establish "une rivière canalizé" by construction of locks and dams, but because funds were limited the only practicable method was to continue the open-river project planned by John Sanders.

River captains, boatowners, and shippers attending a navigation convention petitioned Congress for the return of Captain Sanders to the Ohio River project, and the Chief of Topographical Engineers requested the Chief of the Corps to loan the services of Sanders, as a matter of public interest, for the work. The request was granted, and Sanders, under the general supervision of Colonel Long, resumed charge of the project in early 1843, reemployed his friend Charles Fuller as assistant, built new machine-boats for snagging, and renewed work where it had ended in 1839.

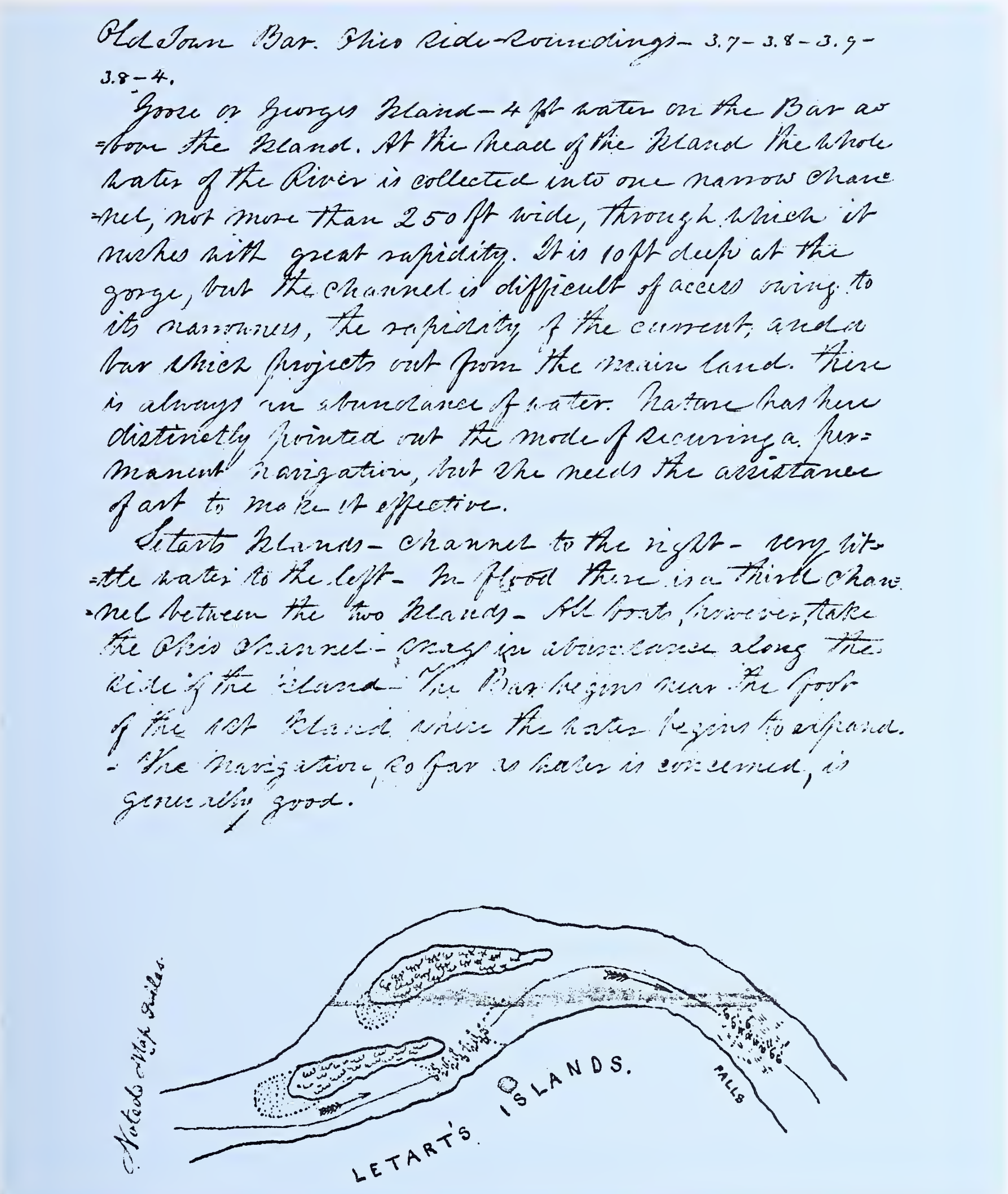
Captain Sanders ordered the machine-boat crews first to clear the river section between Guyandotte, Va. and Greenupsburg (now Greenup), Ky., where Captain Hughes had seen the sunken and grounded steamboats; then he divided the upper Ohio into five districts, assigning a machine-boat and labor force to clear each river district of snags at low water and, when the river was too high for channel work, to cut trees on the banks which might become snags. Sanders employed other men to blast 150-foot-wide channels through rocky shoals. These men stood in the river, drilled holes with sledgehammers and hand drills, inserted tin canisters filled with black powder, and detonated the charges. At one site they removed 250 cubic yards of rock with 666 blasts, consuming seventeen kegs of powder and 1,600 feet of fuse.

Sanders and Assistant Engineer Fuller sought better methods of clearing channels through sand and gravel bars. At first they tried common road scrapers pulled by horses and oxen, but the method was impracticable in swift running water. The dredges then used by Army Engineers in coastal harbors were too heavy and cumbersome for use on shallow inland rivers, but Sanders saw an interesting dredge in use on the Kanawha



—Captain Frederick Way, Jr. Photo

Actual photograph of the St. Louis Harbor about 1856. Snagboat "A. H. Sevier" shown in left foreground.



Old Town Bar. Ohio Side-Soundings- 3.7-3.8-3.9-3.8-4.

Goose or Georges Island-4 ft water on the Bar above the Island. At the head of the Island the whole water of the River is collected into one narrow channel, not more than 250 ft wide, through which it rushes with great rapidity. It is 10 ft deep at the gorge, but the channel is difficult of access owing to its narrowness, the rapidity of the current, and a bar which projects out from the main land. There is always an abundance of water. Nature has here distinctly pointed out the mode of securing a permanent navigation, but she needs the assistance of art to make it effective.

Letarts Islands- channel to the right- very little water to the left- In flood there is a third channel between the two Islands- All boats, however, take the Ohio channel- Snags in abundance along the side of the island- The Bar begins near the foot of the 1st Island where the water begins to expand. - The navigation, so far as water is concerned, is generally good.

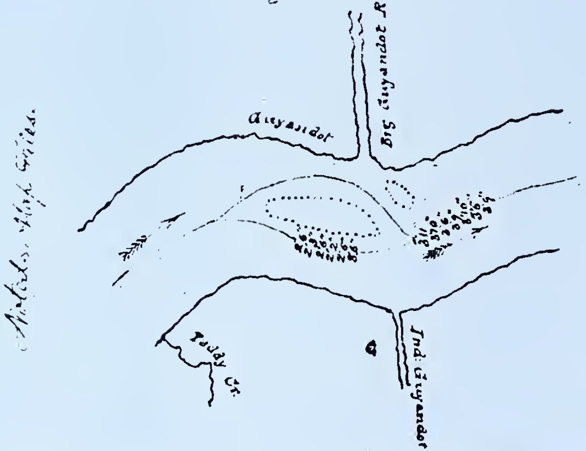
—National Archives

Two handwritten pages from Ohio River Survey by Captain George W. Hughest, Topographic Engineers, U.S. Army in 1842.

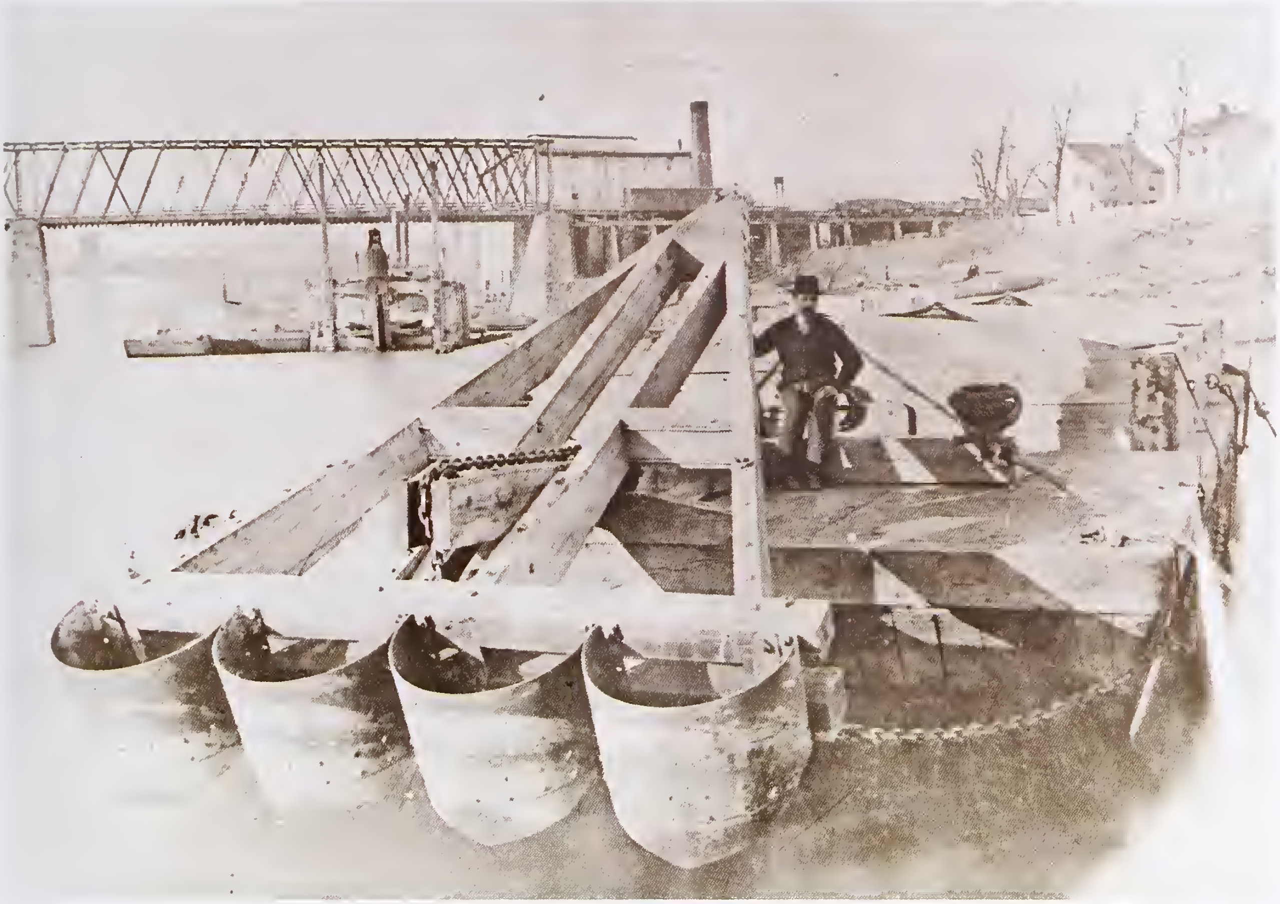
Guyandot October 24th

Raining till 1 o'clock P.M. – despatched copy of Journal to Topl. Bureau – Left at 2 O'clock – River from 3 to 4 inches above low water mark, and slowly rising – occasionally raining during the afternoon.

Guyandotte Lower Bar – immediately below the town – River widely expanded – several steam boats have been aground on these shoals at the same time. The lower are not so difficult as the upper shoals, and require nothing but the removal of a few detached rocks from the bed of the River, and a slight lowering of the bar – but at the upper shoal a Horse Shoe dam running out from the Va. side will be necessary, unless it should be deemed sufficiently important to make a channel close to the town of Guyandotte (the present channel being on the Ohio shore) which would be considerably more expensive. All this, however, properly belongs to the Hydrographical survey already recommended. – Soundings – see sketch



From Symmes creek (4 miles below Guyandotte) to Burlington, four miles lower down, is a dangerous reach for night navigation, as it is much impeded by logs and rocks; although there is generally a sufficiency of water. The steamer Athenian was sunk here, by striking on a snag or rock,



Typical scraper used to deepen navigation channel.

River where the state of Virginia was attempting to improve navigation. Contractors on the state-funded Kanawha River project drove piles in the riverbed about fifty feet apart on both sides of obstructive river bars and moored a flatboat to each set of piles. Two long parallel timbers were laid from boat to boat; on one flatboat horses turned capstans winding a chain attached to a road scraper; and men walked the two timbers between the boats while guiding the scraper across the bar, thereby dredging a deeper channel.

Henry McCarty, one of Sanders' assistants, designed a similar dredge for the Ohio River project. The McCarty dredge was a flatboat mounting a small steam engine which wound a chain attached to a small boat. The little boat supported and guided a scraper, traveled in a flat arc as the steam engine wound the chain, and cut a narrow channel through compacted sand and gravel bars. Captain Sanders placed a McCarty dredge in operation on the Ohio River in August 1843 and found it easily excavated fifty cubic yards of gravel in a single day, transporting the spoil at least 100 feet! Sanders thought the McCarty dredge performed so well that he built four more of them for the Ohio River project.

Sanders also repaired and completed the low stone riprap dams begun before 1839 and contracted for construction of similar dams at such Ohio River landmarks as Belleville Island, Letart Falls, Blennerhassett Island, and Buffington Island. Sanders and Fuller studied their maps of channel and river conditions, staked out the lines of the dams, and contracted with nearby quarry owners to boat stone to the site and drop it into place along the line of the dam. The dam closing the back channel at Buffington Island (Mile 215.5) was 2,260 feet long, 50 feet wide, and 6 feet high. It forced the river at low water to follow the channel on the other side of the island, thereby increasing the flow and depth in the main channel. Wing dams, built out from riverbanks toward the channel, also confined waterflow at low water stages and accomplished essentially the same purpose as dams behind islands. Captain Sanders had completed about thirty of these low riprap dams by 1845, and most of them served navigation needs until locks and dams were built early in the twentieth century.

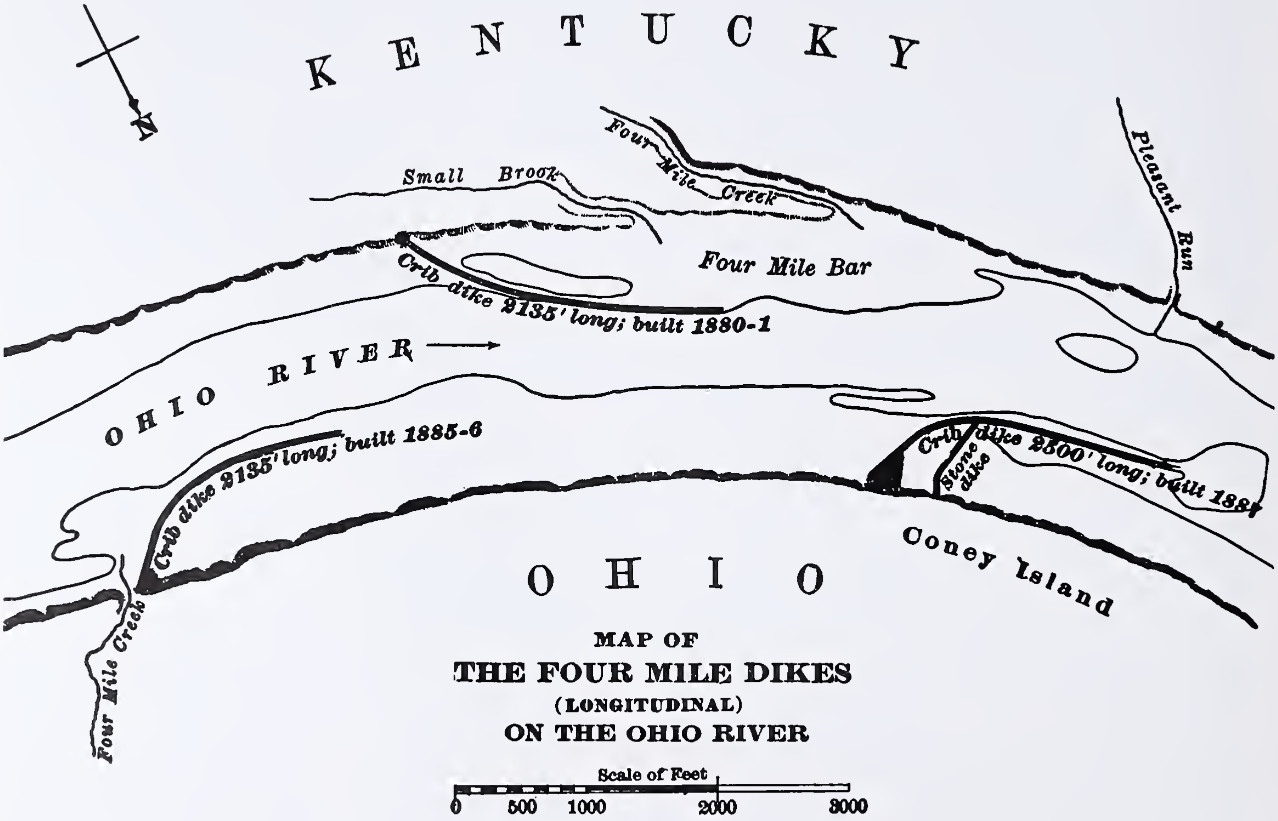
Improvement of inland navigation was stopped for the second time in 1845, when President

James K. Polk and his Democratic administration took office. President Polk believed federal waterway projects were unconstitutional and vetoed every such bill enacted by Congress. Rivermen pointedly referred to obstructive sandbars as "Mount Polk" and described snags as "Polk stalks." An Ohio valley newspaper editor said every snagged boat, every lost life and cargo, would remind people of the valley of President Polk. The Chief of Topographical Engineers made himself unpopular with the Polk administration by publicly urging continued appropriation for the Ohio River project and declaring:The Ohio must forever be a great national thoroughfare; and whatever facilitates its navigation, becomes, in consequence, an object of great national concern."

The Polk administration took office in March 1845. Whig appointee John Russell, the snagboat supervisor, was fired in May. Captain Sanders and Colonel Long sold the snagboats and tools at public auction, or transferred them to the Quartermaster Department, and Sanders was ordered to Texas, where war with Mexico threatened. Charles A. Fuller was employed by Colonel Long to assist in completing minor survey work and in directing construction of marine hospitals for the Treasury Department.

Captain Sanders had made a special report to the Secretary of War in 1838 and 1843 on the military resources of the Ohio valley and had recommended the establishment of naval depots along the Ohio for construction of naval steamboats and ironclad steamships. He believed that in a national emergency the boatbuilders of the Ohio valley could complete a hundred steam supply boats and warships in less than a year and send them downriver laden with Ohio valley produce and manufactured goods to supply American armies and match the naval forces of any potential enemy.

Sanders was given a chance to test his plan in 1846, when General Zachary Taylor, planning to advance up the Rio Grande River and into northern Mexico, sent him back to the Ohio valley to secure steamboats to be used for supply service. In thirty-five days, Sanders acquired fourteen steamboats along the Ohio and returned them to Mexico, where they inaugurated steamboat navigation on the Rio Grande. Sanders rejoined his Engineer unit and led the assault on the Mexican citadel at Monterey by literally cutting his way, through walls and roofs, into the city; he was promoted to Major for his gallantry at the Battle


N
KENTUCKY
Four Mile Creek
Small Brook
Pleasant Run
Four Mile Bar
Crib dike 2135' long; built 1880-1
OHIO RIVER
Crib dike 2135' long; built 1885-6
Crib dike 2500' long; built 1887
Stone dike
Coney Island
OHIO
Four Mile Creek
MAP OF
THE FOUR MILE DIKES
(LONGITUDINAL)
ON THE OHIO RIVER
Scale of Feet
0
500
1000
2000
3000

—G. W. Sutphin

Typical drawing of the lowstone riprap dams built by Captain Sanders.

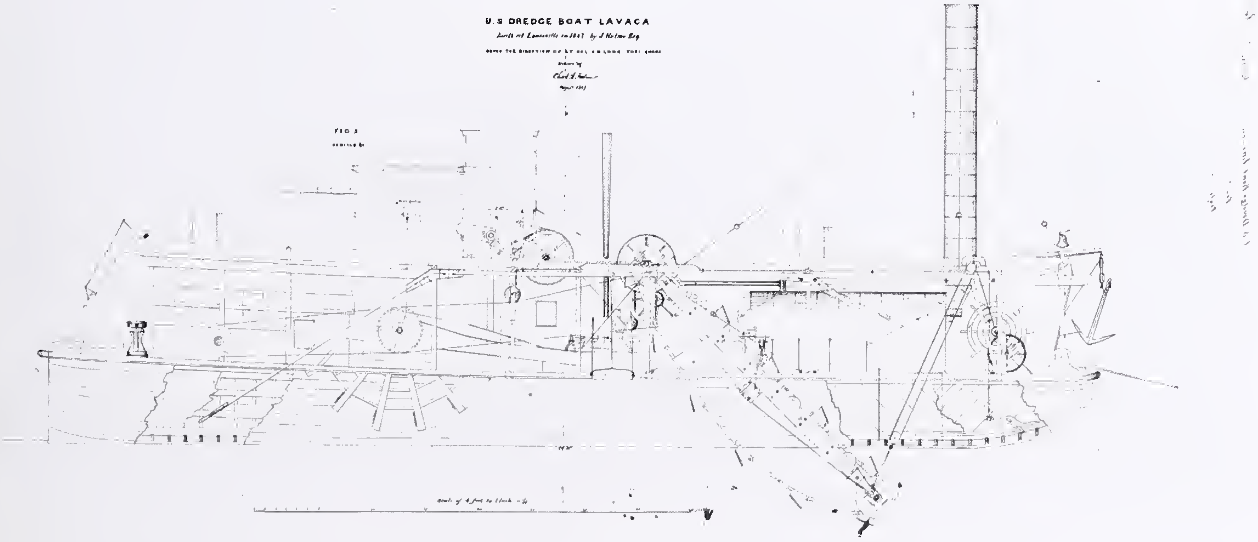
of Monterey.

The Quartermaster Department sent hundreds of boatloads of supplies down the Ohio and Mississippi rivers and across the Gulf of Mexico to supply American troops during the war with Mexico, and built a number of boats for this service. Colonel Long and Charles Fuller directed construction of Quartermaster steamboats on the Ohio River, some of which were oceangoing steamships, equipped with auxiliary masts, rigging, and sails, for service on the Gulf of Mexico. They also built a steam ladder dredge, the *Lavaca,* for use in improving navigation on the Rio Grande.

At the close of the war with Mexico, General Zachary Taylor, the Whig candidate, was elected President, and he and his successor, Millard Fillmore, supported renewed work on the inland rivers. Opposition to federal waterway projects, chiefly on Constitutional grounds, still existed in Congress, however, and disgruntled Western rivermen organized conventions to urge congressional action to clear the inland rivers. "What has Congress done for their improvement?" the rivermen asked. "Nothing—absolutely nothing. And these great arteries, these great inland seas, which waft on their surface annually millions of human beings, and convey on their waters an inland commerce far exceeding that carried across the ocean by the whole domestic and foreign marine, are *now,* so far as navigation is concerned—so far as *improvement* is concerned—but little, if any, better than when the first 'broadhorn' [flatboat] floated down the Ohio and Mississippi rivers fifty years ago, and deposited her cargo of flour and whiskey, after a two months' voyage, in the *Spanish port* of New Orleans." Losses on inland rivers were greater in 1850, the rivermen asserted, than the total of all funds spent that year by the United States for national defense.

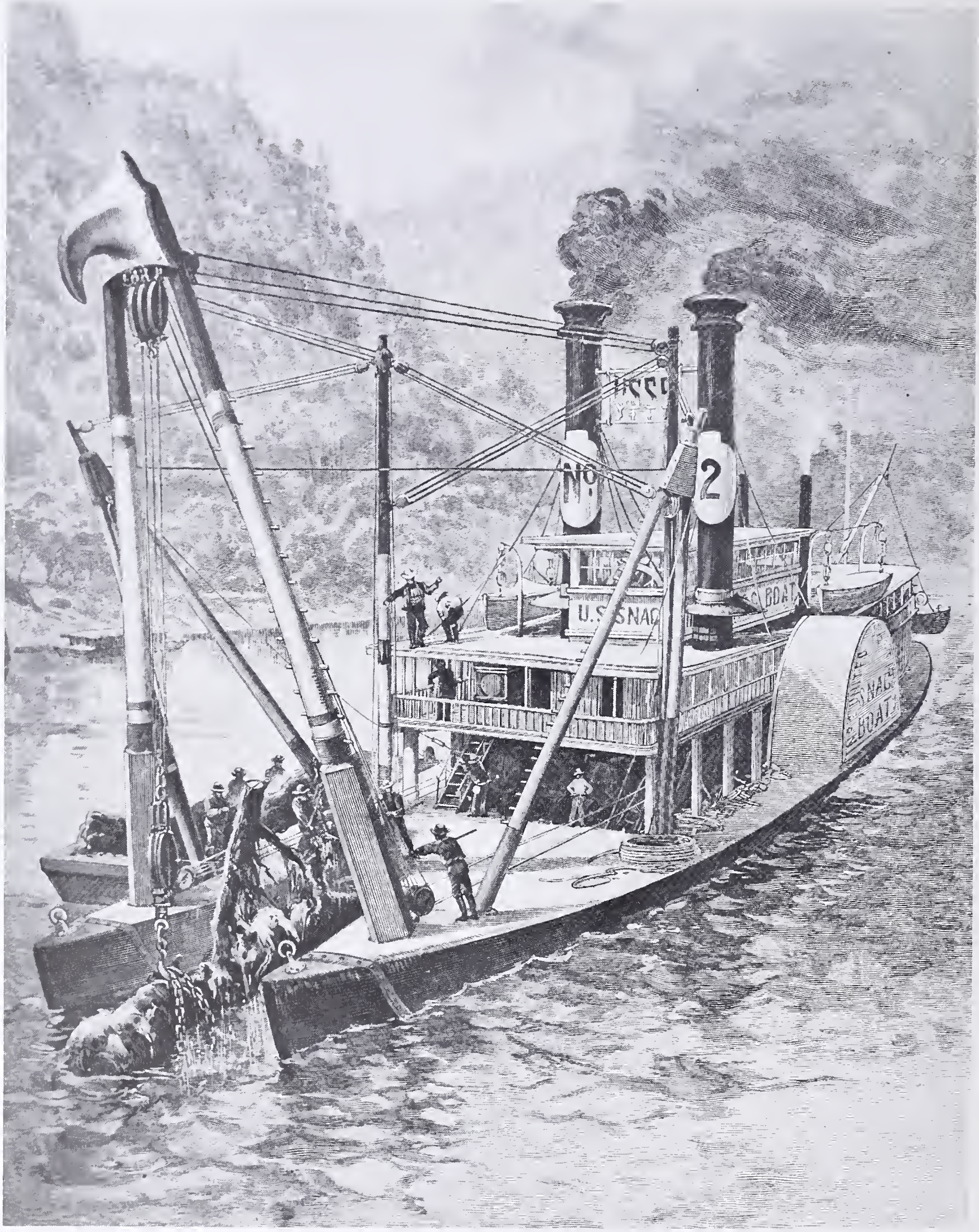
In 1852, the last year of the Taylor-Fillmore administration, proponents of improved waterways navigation in Congress finally enacted an appropriation for waterways. During debates on the bill, one Congressman pointed out to members of the House that since the *New Orleans* inaugurated inland river steamboating in 1811, 166 steamboats had been destroyed by fire, 209 by explosion, and 576 by ramming snags and other obstructions. Another observed that improved waterways would benefit more than just boatowners: "Whatever diminishes the risks and the cost of navigation and the cost of insurance, goes to benefit the producer as well as the consumer; and just as we open safe channels to navigation from the interior of the country, we, to a certain extent, benefit every agriculturalist in the country."

The River and Harbor Act of 1852 provided $150,000 for new snagboats and $90,000 for renewing the work on the Ohio River. The Whig administration authorized reemployment of "Roaring Jack" Russell, and Colonel Long put him back to work building a new fleet of snagboats. Five were built, officially numbered 1 to 5, but also bearing names. No. 5, the *Terror,* was specially built with a light draft for use on the Ohio River. Administration of inland river projects was reorganized by the Chief of Topographical Engineers in 1853, with Colonel Long becom-



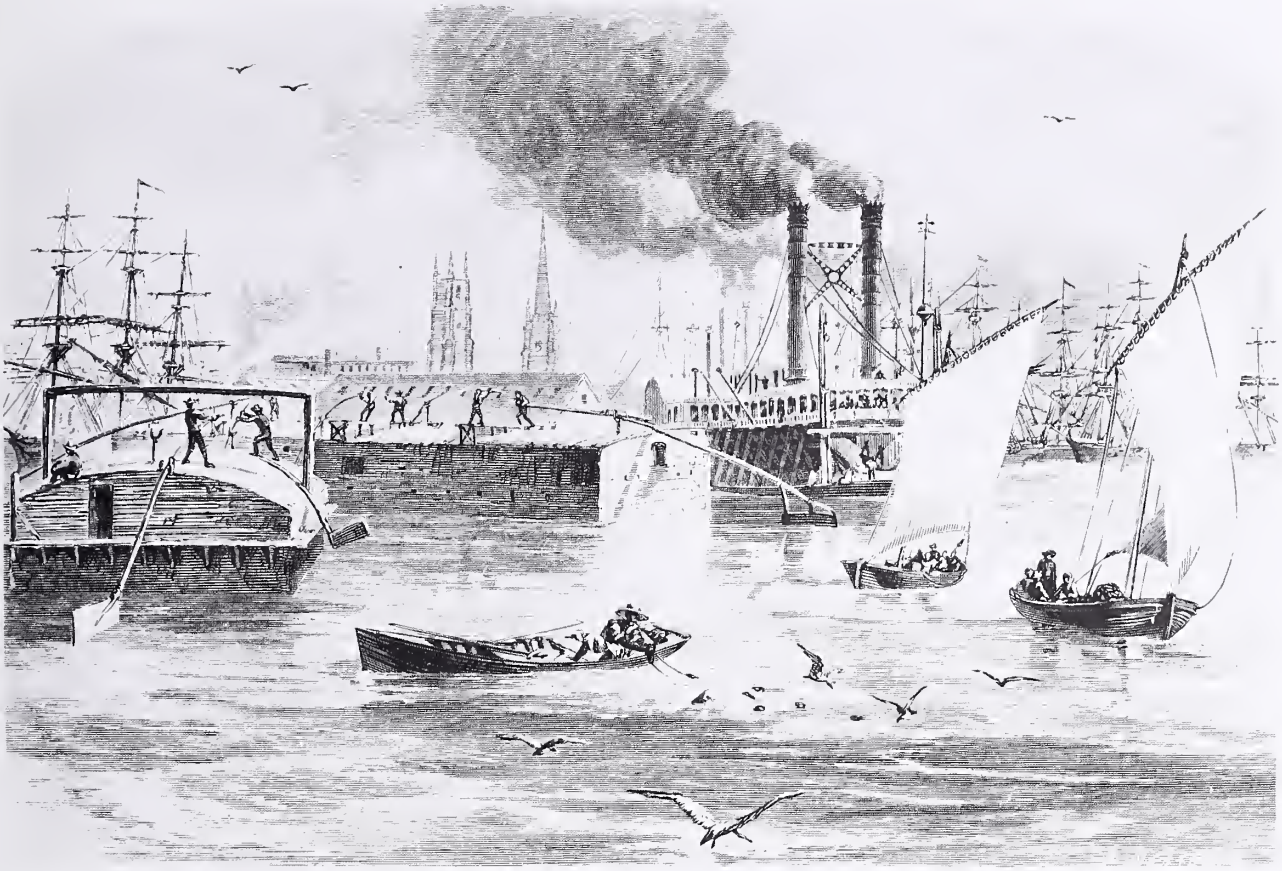
—*National Archives*

Steam ladder dredge, Lavica built during the Mexican War.


No
2
U.S. SNAG
BOAT
SNAG BOAT

—National Archives

U.S. Snagboat No. 2 part of a new fleet of five built in 1852.



—*Picturesque America–1872*

The Mississippi at New Orleans depicting the variety of boating and shipping involved at this important world port. The flatboats, keelboats and river steamers met the sailing ships from other world ports at this point.

ing, in effect, a "Division Engineer" to supervise the work of men in charge of subordinate "Districts." Major John Sanders was performing some pioneer experiments with steampowered piledrivers and concrete construction methods on a fortification project at the time, so Colonel Long selected Charles A. Fuller as "district" Engineer for the Ohio River project.

Major Fuller—Major was an honorary title—sent the snagboat *Terror* up the Ohio to clear the river of hazardous snags, built Bruce machine-boats to handle snags in shallow waters, and built the steam ladder dredge *Gopher* to cut channels with its endless chain of buckets through sandbars and gravel filled channels. Fuller inspected the dams he and Sanders had built on the Ohio between Pittsburgh and Cincinnati and angrily reported that many had been breached, noting a remarkable resemblance between the stone at certain river landings and sawmills and that in neighboring dams. Fuller started repairing the old dams with the funds available, but had to leave most of them unrepaired because no further appropriations for the project were made after 1852.

Democratic President Franklin Pierce, unalterably opposed to federal waterways appropriations, took office in 1853 and vetoed every bill which would have financed further work on the inland rivers. Of course, Pierce fired "Roaring Jack" Russell, the partisan Whig who had served in the Kentucky legislature; and the dismissal precipitated a quarrel between Secretary of War Jefferson Davis and Colonel Long. The Colonel removed Russell as snagboat superintendent as ordered, but retained the old river captain as clerical assistant. Secretary of War Davis thereupon relieved Long from the Western river improvements and appointed Colonel Joseph E. Johnston to the post. Colonel Johnston was a close friend of Secretary Davis, and when Davis became President of the Confederate States in 1860, Johnston left the Engineer Corps to become a General in the Confederate Army.

The quarrel over Russell was forgotten in time, however, and when Colonel Johnston was reassigned in 1855, Colonel Long was returned to the Ohio valley, but merely to wrap up affairs at the Office of Western River Improvements. The office was abolished in 1856, over the protests of Colonel Long, and Colonel Long and Charles Fuller were forced to dispose of the Engineer snagboats and floating plant at public auction. James B. Eads of St. Louis bought the snagboats and converted them into "submarine" boats for use in salvaging wrecked steamboats. And Eads bought them at a propitious time, for without snagboats to clear the rivers the number of wrecked boats rose sharply. Many people lost their lives in steamboat accidents on the inland rivers during the waning years of the 1850's, but Eads and his salvage company made a fortune.

A Lecture to Congress

Colonel Long and Major Fuller went south in 1857 to Louisiana, where funds were left for some work at the mouth of the Mississippi and on the immense logjam in the Red River of Louisiana. By 1857, Colonel Long, who had spent most of his life on the inland rivers, had become bitter about the neglect of navigation on those streams, and, in his last report as Superintendent of Western River Improvements, publicly lectured Congress on its shortcomings. Since 1824, he said, Congress had made appropriations and authorized river navigation projects on three separate occasions, and each time funds sufficient only to build snagboats and begin construction of a few dams had been provided. On each of the three occasions, funds had been cut off just as the work began to reap benefits, and the Engineers had been forced to sacrifice the snagboats and other equipment at public sales, usually for less than a sixth of the cost of construction. In this way, he said, nearly half of all appropriations for waterways since 1824 had been virtually wasted. The Colonel suggested that future Congresses make regular, annual appropriations for waterway improvements, or otherwise expect the same results.

Colonel Long could have been dismissed from the service for his public criticism of Congress, but by 1857 he was seventy-three years old and had completed over forty years of distinguished service with the Corps. He probably wouldn't have cared.

Congress, in any case, was not prepared to act on Long's recommendations. The political and Constitutional controversies that had prevented continuous and effective waterway improvements were also disturbing many other aspects of national life, and they were not resolved before Civil War brought debates on the issues to an end.

Chapter IV

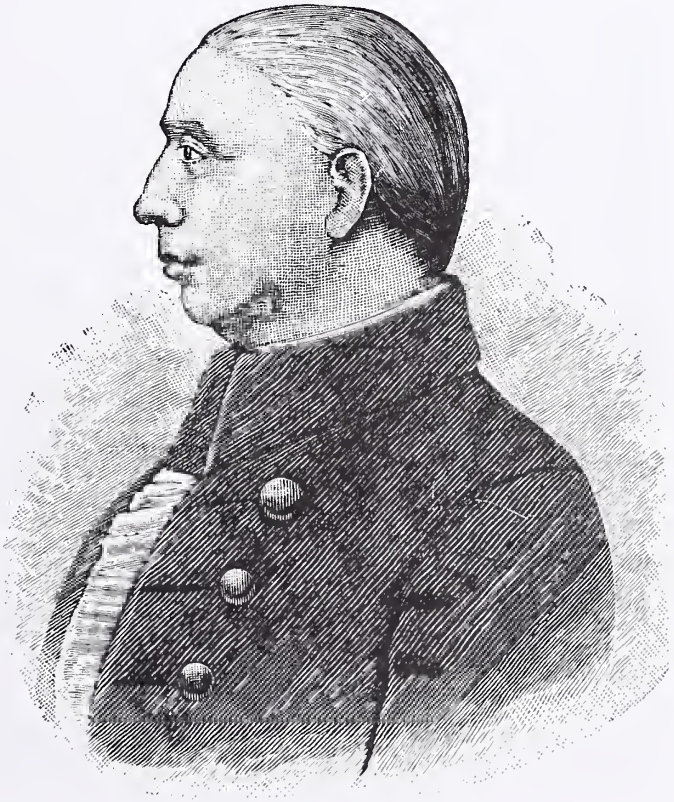
Tributary Waterways Engineering, 1824–1860

General Rufus Putnam, former Chief Engineer of the United States Army, Judge of the Northwest Territory, Surveyor-General of the United States, founder of Marietta, builder of Campus Martius, trustee of Ohio University, and "Father of Ohio," stood at the Marietta wharf, the weight of his eighty-seven years heavy upon him, to watch a steamboat leave for Zanesville on the Muskingum River.

As an officer in the British Army during the French and Indian War, frontier explorer, and Chief Engineer of the Continental Army, Putnam had observed the development of the nation and the Ohio valley from the beginning. He had descended the Ohio River in the galley *Mayflower* to plant an American settlement at the mouth of the Muskingum in 1788; he had observed the growth of commercial flatboat trade on the Ohio and Muskingum, had watched Ohio River ships leaving the port of Marietta to enter foreign trade, and had seen the first steamboats thrashing clumsily up and down the Ohio. Now, in the twilight of his career, he stood at riverside to watch a tiny steamboat begin the first attempt to ascend the Muskingum.

Early Muskingum Steamboating

The steamboat, a little sidewheeler about the size of the *Western Engineer*, with a signal can-



General Rufus Putnam "Father of Ohio" Former Chief Engineer of the United States Army, Judge of the Northwest Territory, Surveyor-General of the United States, Founder of Marietta, builder of Campus Martius, and Trustee of Ohio University.

—*Howe's Historical Collections of Ohio* non on its prow, had been built at Marietta and was named the *Rufus Putnam* in honor of the General. The boat had been tested against Ohio River currents, but when it left the Marietta wharf on January 9, 1824, it was not known whether a steamboat could negotiate the Muskingum.

John Green, the old sea captain who commanded the *Putnam,* wisely chose a time when the Muskingum was at flood stage for his endeavor. Six miles above Marietta, at Rainbow, Captain Green tied up the *Putnam* to visit Captain Jonathan Devol, chief builder of the *Mayflower* and of Marietta ships. Devol, veteran of the Revolutionary Navy, had also witnessed the passing parade of boats on the rivers and the transformation of the Ohio valley from a remote frontier region to an integral portion of the United States—like his old friend Putnam, Devol was in the last year of his life when he inspected the *Putnam.*

After its pause at Rainbow, the first steamboat on the Muskingum splashed upstream to Luke Chute, the whitewater rapids thirty-four miles above Marietta, where Captain Green tied up for the night to await daybreak before traversing the rapids. The *Putnam* conquered Luke Chute the next morning, and that night landed at Putnam, a village across the Muskingum from Zanesville, where it met with a reception lasting two days. On January 13, Captain Green pointed the prow of the *Putnam* toward home, and, racing on the crest of the flood, made the return trip from Zanesville to Marietta in just seven hours. Captain Green began regular runs with the *Putnam* to Zanesville. It was said the boat had no need for its signal cannon, because the captain's reverberating voice let the people along the Muskingum know well in advance of the boat's impending arrival.

The voyage of the *Putnam* inaugurated a steamboat commerce on the Muskingum that was to continue more than a century. Traffic was sporadic at first, but profitable, and boats ran frequently between Zanesville and Marietta, Parkersburg, and Pittsburgh. In 1829, the steamer *Mary Han* reached Coshocton, where the Walhonding and Tuscarawas rivers unite to form the Muskingum. Small boats, like the *Tuscarawas* and the *Zanesville-Dresden Packet,* also steamed up to Coschocton on occasion. With the launching of the *Hope,* a little steamer that carried a pony to tow it up rapids, Zanesville even became something of a steamboat construction center.

Steamboat traffic on the Muskingum, augmenting the already large flatboat and keelboat commerce, generated great public support in the valley for the improvement of river navigation. Under the congressional policy of limiting federal waterways appropriations to rivers passing through or bordering several states, the Muskingum, flowing wholly within Ohio, did not qualify for federal assistance. The people of the Muskingum valley therefore looked to the state for aid. Fortunately, Ohio, inspired by the success of the Erie Canal in New York was embarking on an extensive canal construction program during the 1820's, and citizens of the Muskingum basin were able to obtain a project for improvement of Muskingum River navigation as part of the state canal system.

Canalization of the Muskingum

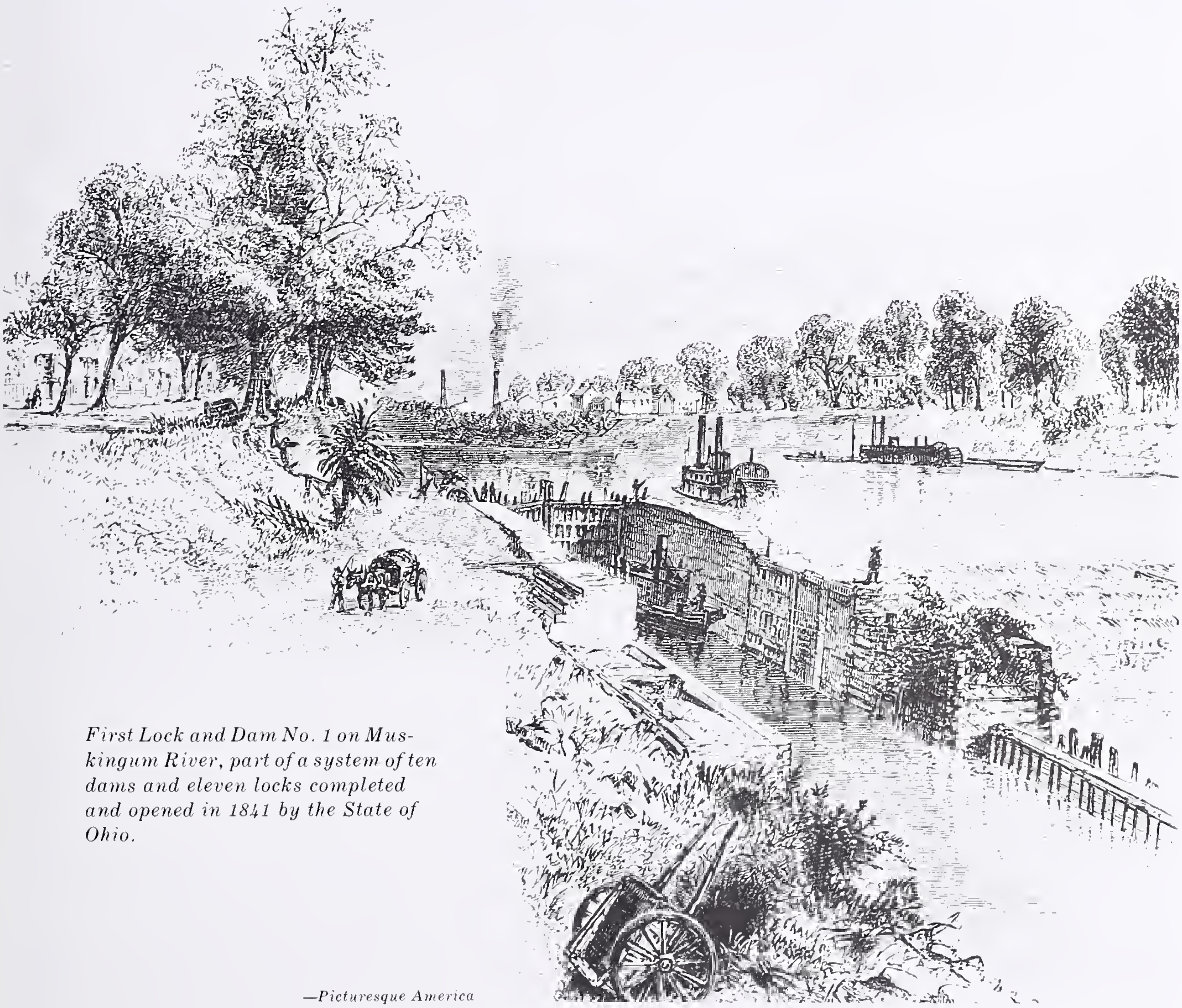
The Ohio canal commissioners examined the Muskingum in 1827 to determine if it were feasible to improve navigation and connect the stream with the Ohio and Erie Canal at Dresden. They reported the Muskingum could be improved for canalboat and steamboat navigation by constructing locks and dams to canalize the river; that is, to establish slackwater pools to make the river like a canal. A dam for waterpower and a canal for navigation had been built around the Falls of the Muskingum at Zanesville by the Zanesville Canal and Manufacturing Company in 1816, and in 1828 Zanesville merchants suggested construction of a lock and dam at the head of the pool formed by the Zanesville waterpower dam to open slackwater navigation on the Muskingum up to Dresden, where connection could be made with the Ohio and Erie Canal. The state authorized this project in 1832, and a lock and dam was completed in 1834 near Symmes Creek, four miles downriver from Dresden. The Symmes Creek lock, built for canalboats and small steamers, had a tiny lock chamber, for boats no larger than 104 by 21 feet, and was mislocated a bit too far upstream of the Zanesville slackwater pool, resulting in suspension of navigation between Zanesville and Dresden at low water stages.

The state undertook complete canalization of the river from Marietta to Zanesville in 1836 and employed Major Samuel R. Curtis, former infantry officer and a West Point graduate, as project engineer. Curtis surveyed the river in flatboats from Zanesville to Marietta in 1836, located sites for locks and dams, and established the project office at McConnelsville. He found two waterpower dams with sluice gates, instead of locks for navigation, already built on the river. James Taylor of Taylorsville (Philo) and Robert McConnel of McConnelsville had been granted the privilege of building the dams in 1828 and 1830. Taylor's dam became Dam 9 of the navigation project and McConnel's became No. 7. The owners retained perpetual rights to use the waterpower at the dams and passed the rights from hand to hand over the next century; as late as 1932 the Ohio Power Company held Taylor's waterpower rights, which were used to supply water for the condensers of the company's steam-electric plant at Philo.

Major Curtis and the state canal board planned a system of ten dams and eleven locks from Zanesville downriver, supplementing the Symmes Creek lock and dam. There were more locks than dams because the dam at Zanesville had a flight of two lock chambers, to raise boats in two steps from the lower to the upper slackwater pool. Curtis opened construction bids at the McConnelsville office and work was begun in 1837.

The dams were built of timber cribs, resembling log cabins, pinned at the corners with iron rods, which were dropped into the river side by side from bank to bank. The cribs were filled with random stone from nearby quarries, planks were pinned atop the cribs to hold the stone, thick boards were driven along the upstream face of the cribs to foundation rock to reduce seepage, and rocks were dropped into the river above and below the cribs to prevent washout. The dams leaked and were often breached by floods, thus greatly increasing maintenance costs over the years, but stonefilled timber cribs were standard at the time. Similar dams were built on the Monongahela in Pennsylvania, the Green and Kentucky rivers in Kentucky, and the Coal and Guyandotte rivers in western Virginia during the same period.

Monolithic concrete river locks were not built in the United States until 1895, and all locks built before 1895 were of either cheap rockfilled timber cribs, or more expensive stone masonry. Major Curtis designed cut-stone masonry locks for the



First Lock and Dam No. 1 on Muskingum River, part of a system of ten dams and eleven locks completed and opened in 1841 by the State of Ohio.

—Picturesque America

Muskingum, with room in the lock chambers for 160-foot-long and 35-foot-wide boats. The dimensions were ample for most steamboats in 1837, but marine engineers constantly increased the size of steamers to permit handling larger payloads, and steamers that could enter the Muskingum River locks were eventually classed as small boats. The locks adjoined six of the dams, and passage from one pool to the next was as swift as men could open and close the lock valves and gates by hand. At four dams however, the locks were in canals bypassing the dams, and the canals increased maintenance costs, because they filled with mud and sludge at every flood and required expensive dredging.

Major Curtis employed young John Sherman as rodman during the Muskingum survey and was so impressed with his ability that he made him resident engineer at the Beverly lock and dam (No. 4). Sherman later recalled the work on the project as unpleasant. Workmen received daily "jiggers" of whiskey as part of their compensation and were an unruly crew. They once attacked a temperance speaker at Beverly. Sherman received his first political experience when the state administration changed in 1838 and Major Curtis was dismissed as project engineer for political reasons. Sherman and several friends of the Major signed and mailed a petition to the new Governor in support of Curtis—they promptly joined Curtis in the ranks of the unemployed.

Sherman then borrowed money to purchase a flatboat and a cargo of Muskingum valley produce and set out downriver to Cincinnati to sell it and make a fortune. But 1838 was a year of record low water, and Sherman got his boat only down to Luke Chute, where navigation ceased. Thus was a promising career as river captain quickly cut short. Sherman returned to law school, entered politics, and represented Ohio in Congress, and eventually served as Secretary of State and Secretary of the Treasury.

Major Curtis left Ohio for Iowa, where he also entered politics, representing Iowa in Congress. He later became a Major General in the Union Army.

Many mistakes were made in building the Muskingum navigation project which would not have been made at a later date, but it was one of the first navigation projects completed in the United States when it opened in 1841. Waterways engineers did not then know how to anchor miter sills, the structures on lock floors against which lock gates rest when closed, to foundation rock, and the practice was to attach the miter sills to timbers covering the floors of lock chambers. The method was standard in 1841, but on the Muskingum project yellow-poplar timbers were used which quickly rotted and leaked badly. Stone masonry had been commonly used for construction since ancient times, but ordinary lime mortar was used on the Muskingum locks as sealer between the stones, and it soon washed out, the stone masonry began to slide, and the lockwalls had to be bolted together to prevent complete collapse.

The white-oak lock gates were first opened and closed by men turning windlasses attached by chains to each leaf of the lock gates; it took four men turning cranks at each gate, eight at each lock, to open and close the gates. A direct rack-and-pinion was eventually installed at each lock gate to reduce the size of the lock force, but locking through the Muskingum was always a slow process.

In spite of its many design shortcomings and operational problems, the Muskingum project, at a construction cost of $1,628,028.29, established a slackwater navigation system that was much more reliable than navigation on the Ohio. Ohio River boats often took refuge in the Muskingum slackwater during low water seasons.

Captain John Sanders of the Corps of Engineers examined the Muskingum project in 1843 and commented that Muskingum River commerce was booming and becoming of "great importance." The state collected over $50,000 in tolls and waterpower rents in 1847, the peak year, and revenue averaged about $40,000 a year from 1843 to 1853, when railroad competition began to make inroads. The mayor of Marietta proudly told the Secretary of War in 1853 that more passengers and freight entered the Ohio from the Muskingum River than at any other point on the river above Cincinnati.

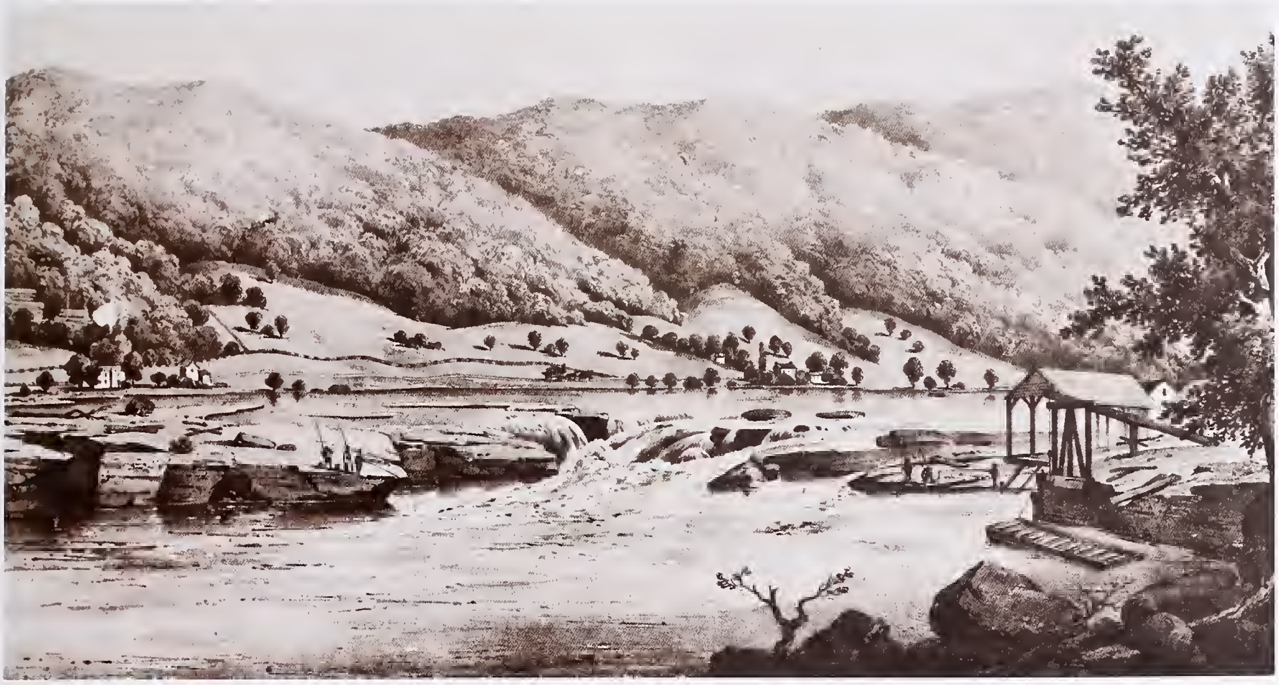
River traffic declined, however after 1853, and operating costs began to exceed revenues. By 1860 the state had begun to look for someone to take over the project and try to make it a paying proposition. The United States eventually became willing to give it a try.

Navigation South of the Ohio

South of the Ohio River, three pioneer navigation projects were built before the Civil War. Virginia undertook the improvement of Kanawha River navigation as a section of the James River and Kanawha Canal project. And state-chartered private corporations supported by state funds built slackwater projects on Coal River, a tributary of the Kanawha, and on Guyandotte River, a stream entering the Ohio at Guyandotte, now a part of Huntington.

Kanawha River Navigation

The Kanawha River, actually the lower course of the New River, which rises in North Carolina and rushes, in places, through deep-cut gorges



—*Album of Virginia*
Illustrated by Ed Beyer

Kanawha Fall
Late in 1812, the Marshall Commission recommended cutting canal around Fall.

across southwestern Virginia and West Virginia to join the Ohio at Point Pleasant, was an important route for explorers and immigrants bound for the Ohio valley and served the pioneers as an outlet to market at an early date. It will be recalled that John May was killed by Indians in 1790 while piloting a flatboat from Kelly's Station on the Kanawha to Maysville on the Ohio.

Commerce on the Kanawha after 1808 centered around the saltworks on the river above present Charleston, W. Va., where salt brine was boiled and the product packed in barrels and shipped downriver in flatboats, largely to the dozens of meatpacking plants at Cincinnati. Thirty salt furnaces in the Kanawha valley were shipping 700,000 bushels of salt annually in 1817, and production rose to over 3,000,000 bushels in 1846. Many flatboats were built along the Kanawha and such tributaries as the Elk and Coal rivers for use in the salt commerce; keelboats also plied the river regularly to furnish supplies for the saltworks; and the Kanawha coalfields were first developed to supply fuel for the saltworks.

The salt trade brought the first steamboat to the Kanawha in early 1819, when the crude little *Robert Thompson*, a barge-like sidewheeler, attempted to steam upriver to the saltworks. For two days the boat tried to ascend the rapids of Red House Shoal, twenty-five miles below Charleston, but could not stem the current and returned downriver to the Ohio. The *Robert Thompson* in 1822 became the first steamboat to ascend the Arkansas River, but at Red House Shoal in 1819 it had met its master.

Andrew Donnally, owner of Kanawha salt furnaces, brought his steamboat *Andrew Donnally* up to Charleston in 1820, and in 1823 he brought up the steamer *Eliza*. These boats lacked the power needed for regular trade on the Kanawha, but more powerful boats were soon built.

Kanawha flatboatmen improved the river by removing boulders and snags, but the introduction of steamboats on the Kanawha stimulated, as it did on the Ohio and Muskingum, demands for safer and more reliable navigation. There was sympathy for these demands in the Virginia legislature, and a project to improve navigation on the James and Kanawha rivers and to link the two streams by road or canal, thus opening the Ohio River trade and the mineral resources of western Virginia to Richmond markets, had long been considered.

A Vision of James River and Kanawha

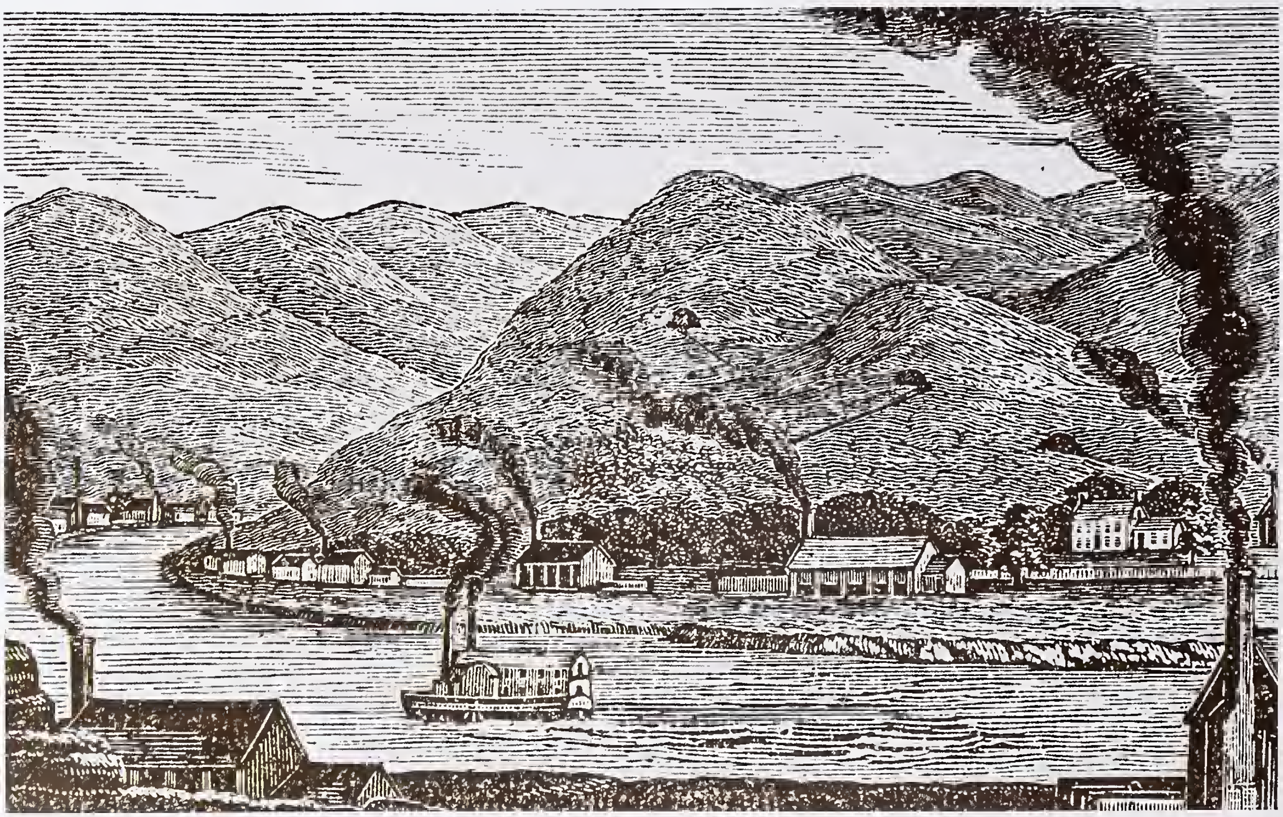
Thomas Hutchins, before the American Revolution, had reported the Kanawha navigable to the Falls, about ninety-five miles above its mouth, and had suggested that trade between the Kanawha and James valleys might be quite profitable. George Washington, after study of Hutchins' maps, recognized the possible value of such a transportation route and lent his support to the James River Company, chartered by Virginia in 1785 to improve James River navigation, build a road to the Kanawha, and improve the Kanawha to the Ohio. Little was accomplished by the company on the connecting road and the Kanawha, however, and in 1812 the Virginia General Assembly appointed a commission headed by John Marshall, Chief Justice of the Supreme Court, to study the proposed project.

The Marshall Commission traveled up the James in late 1812, pulled their boat over the mountains, and descended the Greenbrier, New, and Kanawha rivers to the Falls of the Kanawha. Navigating the Greenbrier and New rivers required much hard work and considerable valor, for their channels were greatly obstructed by boulders and rapids. Even with the help of horses, the labor of moving boulders from the channel and dragging the boat was so great that it took the Marshall party ten days to descend forty-eight miles of the Greenbrier to the New River. Falls on the New and Kanawha were so difficult that navigating them was not attempted: Chief Justice Marshall and his colleagues hauled their boat around the falls on skids.

The Marshall Commission reported, however, that the route was commercially promising, and recommended a project to cut canals around fall, canalize other river sections, and build a road between the James and Kanawha valleys.

Virginia deferred action until after the War of 1812, then employed civil engineer Laommi Baldwin to study the route. He, too, reported the project feasible and recommended improvement of Kanawha River navigation by removing snags and boulders, widening and deepening channels through shoals, and building a dam with lock, to submerge Red House Shoal.

After an instrument survey of the James River and Kanawha Canal route in 1819, state engineers Thomas Moore and Isaac Briggs planned improvement of Kanawha navigation by clearing its channels. "When the river is low," they declared, "commerce is greatly interrupted, and the persons engaged in it suffer great loss and inconvenience; which would be completely removed, by the proposed improvement. With a good navigation on the river, it is hardly possible to anticipate the extent to which the commerce on it



—Historical Collections of Virginia
by Henry Howe (Charleston, S.C., 1845)

Salt Works on the Kanawha River in the early 1800's. This industry started the steamboats up the river as early as 1819.

would be carried."

On February 17, 1820, the state authorized a project to improve Kanawha River and James River navigation and to connect the two streams by road. A "sluice" navigation project, involving clearing channels, dredging bars, building wing dams, and excavating "dug chutes" at least forty feet wide through Red House and other Kanawha River shoals, was undertaken on the Kanawha. By 1830 the state had expended $91,766.72 on the work with considerable benefit to navigation. Steamboats ran regularly up the Kanawha to the saltworks after 1825, and scheduled packet service was established from Charleston to Point Pleasant, Gallipolis, Cincinnati, Parkersburg, and Pittsburgh. Steamboats landed at Charleston 104 times in 1841 and 156 in 1842. As early as 1829, Kanawha steamers began towing keelboats down the river to Maysville and Cincinnati, these being among the first tows on the inland rivers. The keelboats were towed at the rear and sides of the steamers, not pushed like present-day barge tows.

The Kanawha was annually worked over to maintain the channel. Machine-boats cleared snags and boulders; simple dredges called "scraper-boats" removed sand and gravel from the dug-chutes and bars; buoys were installed for the guidance of pilots; and ring bolts were set into rock above rapids for boats to tie to when warping upriver against the current. Managers of the project, admitted, however, the project was inadequate for the traffic. Kanawha River shippers were far from happy with the project, and, just as Ohio River shippers asserted the United States neglected inland rivers in favor of seacoast harbors, Kanawha shippers were convinced that Virginia expended a disproportionate share of available funds on Tidewater rivers while neglecting the interests of western Virginians in the Kanawha navigation—an embryonic form of the sectionalism that was to break Virginia apart in 1861.

Partly in response to western complaints, Virginia reorganized administration of the project in 1835, placing management in the hands of a largely state-owned corporation, the James River and Kanawha Company. That company employed Benjamin Wright, former chief engineer of the Erie Canal, who was later acclaimed as the "Father of American Civil Engineering." who was assisted by a brilliant young engineer, Charles Ellet, Jr. These two men moved quickly in laying plans for extending a canal up the James from Richmond to Covington, building a railroad from Covington to the Kanawha, and constructing locks and dams at the more difficult shoals on the Kanawha.

Ellet became chief engineer for the company in 1836, and he directed an active construction program on the James River Canal. The canal was opened from Richmond to Lynchburg in 1840, and on to Buchanan in 1851. But Ellet was discharged for political reasons in 1839 and the improvement of the Kanawha languished.

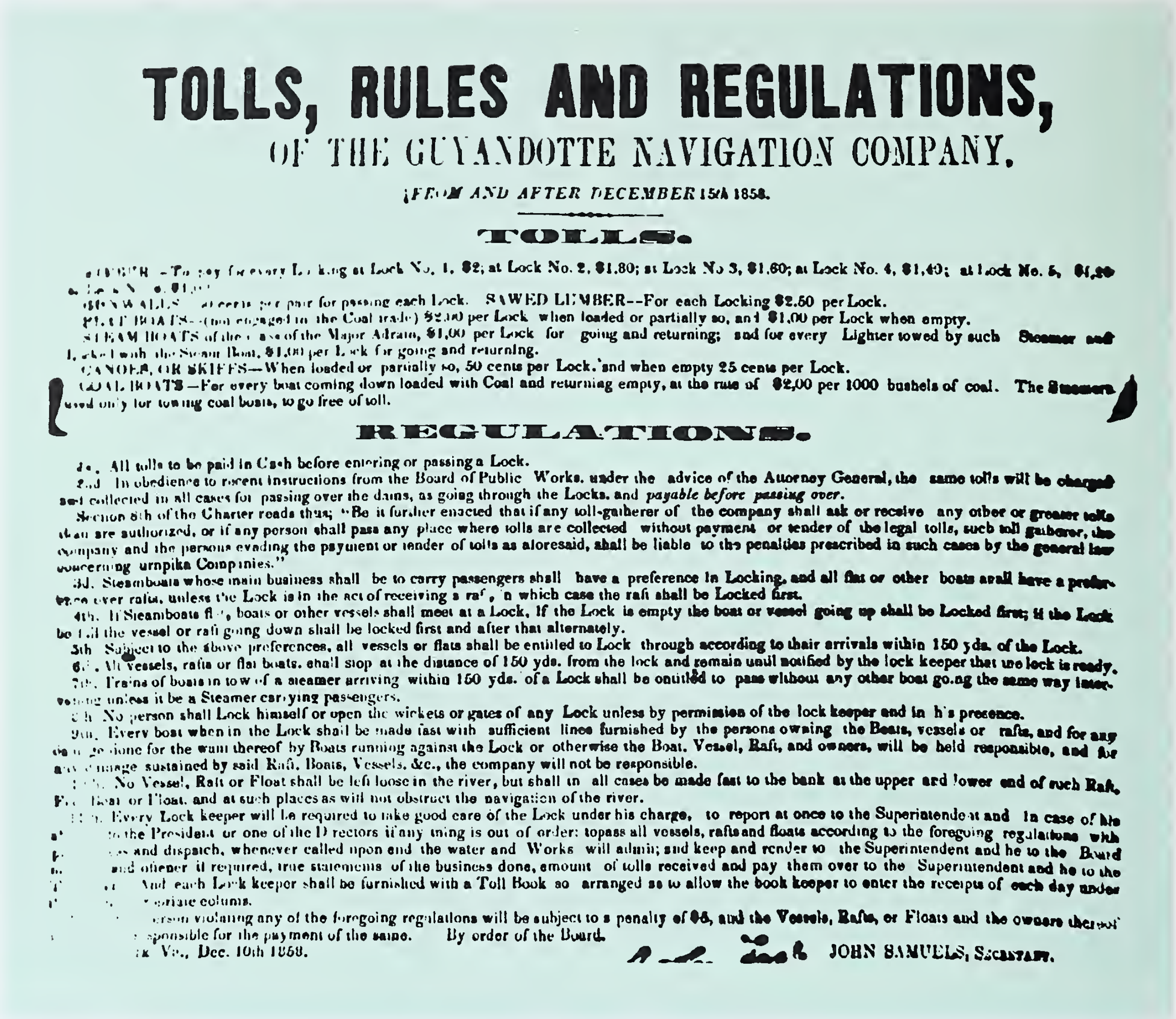
While Virginia was seeking to open a route to the Ohio River, the market for the coal of western Virginia was growing, and private corporations, with some state assistance, were beginning construction of pioneer slackwater projects on the Guyandotte and Coal rivers to open coal resources. Coal, which evolved as the joy and bane of West Virginia, was first mined in the Kanawha valley in 1817, but until about 1840 it was consumed only locally, by the saltworks. Alva Hansford shipped the first flatboat load of coal down the Kanawha to Cincinnati in 1840, and the race began, for coal from the Monongahela fields was already descending the Ohio and Mississippi rivers, and capitalists thought they might grab part of this trade by opening fields along the Kanawha, Guyandotte, or Big Sandy rivers which were closer to market than the Monongahela fields.

Guyandotte River Canalization a Victim of Ineptness

Guyandotte, the village at the mouth of the Guyandotte River, had become an important Ohio River port after completion of the Kanawha Turnpike to the town in 1834, but little was known about the coal resources of the Guyandotte basin until 1848. The coal of the upper Guyandotte basin was to make Huntington, W.Va. the greatest riverport on the inland rivers in the twentieth century.

State engineer Joseph H. Gill surveyed the Guyandotte from its mouth to Gilbert Creek, about twenty-two miles above Logan Court House, in 1848, and issued a report describing the immense timber resources and coal measures he saw. He recommended that the state build a slackwater navigation project to Logan, and clear the river for "sluice" navigation above Logan, to permit development of the rich resources. With mills at each dam to utilize waterpower, and abundant supplies of coal, iron, and lumber, Mr. Gill predicted the Guyandotte navigation project would convert the region into a manufacturing area. He warned, however, that the sudden and devastating floods on the Guyandotte made solid and substantial locks and dams imperative.

Virginia incorporated the Guyandotte Navigation Company in 1849 and agreed to purchase three-fifths of the company stock, once private interests had raised the remainder. Capital was largely supplied by New York investors. Sotckholders met at the Hotel Whitney in Guyandotte in 1850, elected Peter Clark of



TOLLS, RULES AND REGULATIONS,
OF THE GUYANDOTTE NAVIGATION COMPANY.
FROM AND AFTER DECEMBER 15th 1858.

TOLLS.

[illegible] —To pay for every Locking at Lock No. 1, $2; at Lock No. 2, $1.80; at Lock No 3, $1.60; at Lock No. 4, $1,40; at Lock No. 5, $1,20 [illegible] $1,00

GUNWALES [illegible] cents per pair for passing each Lock. SAWED LUMBER--For each Locking $2.50 per Lock.

FLAT BOATS—(not engaged in the Coal trade) $2.00 per Lock when loaded or partially so, and $1.00 per Lock when empty.

STEAM BOATS of the class of the Major Adrain, $1,00 per Lock for going and returning; and for every Lighter towed by such Steamer and locked with the Steam Boat, $1,00 per Lock for going and returning.

CANOES, OR SKIFFS—When loaded or partially so, 50 cents per Lock, and when empty 25 cents per Lock.

COAL BOATS—For every boat coming down loaded with Coal and returning empty, at the rate of $2,00 per 1000 bushels of coal. The Steamers used only for towing coal boats, to go free of toll.

REGULATIONS.

1st. All tolls to be paid in Cash before entering or passing a Lock.

2nd. In obedience to recent instructions from the Board of Public Works, under the advice of the Attorney General, the same tolls will be charged and collected in all cases for passing over the dams, as going through the Locks, and *payable before passing over.*

Section 8th of the Charter reads thus; "Be it further enacted that if any toll-gatherer of the company shall ask or receive any other or greater tolls than are authorized, or if any person shall pass any place where tolls are collected without payment or tender of the legal tolls, such toll gatherer, the company and the persons evading the payment or tender of tolls as aforesaid, shall be liable to the penalties prescribed in such cases by the general law concerning Turnpike Companies."

3d. Steamboats whose main business shall be to carry passengers shall have a preference in Locking, and all flat or other boats shall have a preference over rafts, unless the Lock is in the act of receiving a raft, in which case the raft shall be Locked first.

4th. If Steamboats flats, boats or other vessels shall meet at a Lock, If the Lock is empty the boat or vessel going up shall be Locked first; if the Lock be full the vessel or raft going down shall be locked first and after that alternately.

5th Subject to the above preferences, all vessels or flats shall be entitled to Lock through according to their arrivals within 150 yds. of the Lock.

6th. All vessels, rafts or flat boats, shall stop at the distance of 150 yds. from the lock and remain until notified by the lock keeper that the lock is ready.

7th. Trains of boats in tow of a steamer arriving within 150 yds. of a Lock shall be entitled to pass without any other boat going the same way intervening unless it be a Steamer carrying passengers.

8th No person shall Lock himself or open the wickets or gates of any Lock unless by permission of the lock keeper and in his presence.

9th. Every boat when in the Lock shall be made fast with sufficient lines furnished by the persons owning the Boats, vessels or rafts, and for any damage done for the want thereof by Boats running against the Lock or otherwise the Boat, Vessel, Raft, and owners, will be held responsible, and for any damage sustained by said Raft, Boats, Vessels, &c., the company will not be responsible.

10th. No Vessel, Raft or Float shall be left loose in the river, but shall in all cases be made fast to the bank at the upper and lower end of such Raft, Flat, Boat or Float, and at such places as will not obstruct the navigation of the river.

11th. Every Lock keeper will be required to take good care of the Lock under his charge, to report at once to the Superintendent and in case of his [illegible] to the President or one of the Directors if any thing is out of order: to pass all vessels, rafts and floats according to the foregoing regulations with [illegible] and dispatch, whenever called upon and the water and Works will admit; and keep and render to the Superintendent and he to the Board [illegible] and oftener if required, true statements of the business done, amount of tolls received and pay them over to the Superintendent and he to the [illegible] And each Lock keeper shall be furnished with a Toll Book so arranged as to allow the book keeper to enter the receipts of each day under [illegible] appropriate columns.

[illegible] person violating any of the foregoing regulations will be subject to a penalty of $5, and the Vessels, Rafts, or Floats and the owners thereof [illegible] responsible for the payment of the same. By order of the Board.

[illegible] Va., Dec. 10th 1858.

JOHN SAMUELS, Secretary.

—*Virginia State Archives*
Richmond, Virginia

Guyandotte president of the company, appointed Colonel Cyrus Moore superintendent of the navigation project, and employed Captain George McDaniel, a former contractor from Maine, to direct construction.

Captain McDaniel arrived at Guyandotte on July 17, 1850, with fifty laborers and went to work on a lock and dam a mile above the mouth of the river. State Engineer Gill visited the worksite in late July and was disturbed by what he found: the company was not following the plans he had formulated. He reported the company had mislocated the first dam, probably preventing access from the Ohio at low water and requiring changes in location for upstream dams, and was building the lockwalls of cheap rockfilled timber cribs, not stone masonry, which Gill thought necessary because of the destructive floods. Another state investigator confirmed what Gill had reported. The company was building 142-foot by 20-foot timber-crib locks because their construction cost only $8,000, while with stone masonry they would have cost $20,000 each: and the company had changed the location of the dams and increased their heights to eliminate some of the locks and dams necessary to canalize the river to Logan. In spite of these reports, the Virginia Board of Public Works permitted the company to proceed with the project.

With a 200-man work force, the company had five locks and dams nearly completed by the end of 1850, and it expected to complete canalization to Logan in another working season. Dam 1 was located about a mile from the Ohio, No. 2 eight miles up river, No. 3 at Mile 13, No. 4 at Mile 22, and No. 5 about thirty-one miles above the mouth of the stream. Troubles began in 1851. After Dams 3 and 4 were completed, the company learned that No. 3 did not back water up to No. 4, nor did No. 4 provide sufficient slackwater to reach No. 5. The company had also rushed into construction without clear titles to the land, and it thus became involved in litigation which forced suspension of construction. While construction was suspended, floods breached the dams and the company went bankrupt.

The Webb brothers and the Guyandotte Land Company, of New York, which owned over three million acres in the Guyandotte basin and wished to market timber and coal from its lands via the river, purchased control of the insolvent navigation company in 1853. General J. Watson Webb, former United States Minister to Austria and owner of a New York newspaper, was the prime organizer of the land company, and his brother Henry L. Webb became superintendent of the Guyandotte navigation project. The Webbs, with fresh capital, renewed construction, repaired and raised the first five locks and dams, and built a sixth dam between No. 4 and No. 5 to establish four-foot slackwater about forty-five miles up the Guyandotte. The company also built a seventh dam at the Falls of the Guyandotte to power its sawmill.

The Guyandotte Land Company acquired the little steamboat *Major Adrian* and in 1855 began barging coal from above the Falls of the Guyandotte, from Fourmile and Ninemile creeks, downriver through the locks to the Ohio. A steam packet, the *Lindsey*, also began running up the Guyandotte to Barboursville and other landings along the stream, taking in groceries and dry goods and hauling out furs, ginseng, and farm produce.

But the cheaply constructed locks and dams required expensive repairs after every flood. At low water, boats could not navigate the mile of unimproved river below Dam 1. And the *Major Adrian* sank on the Guyandotte and gradually went to pieces. The new company was near insolvency by 1861 and was unable to maintain the project. Union soldiers breached Dam 1 in 1861 to get supplies upriver to a camp at Barboursville, and the great flood of 1861 destroyed the project forever.

When Colonel Merrill of the Corps of Engineers examined the Guyandotte in 1875 he found only traces of the dams remaining. "This is one of the many illustrations," he said, "of the total destruction of useful hydraulic works, either by the decay of perishable materials used in construction or by radical defects in the plans of the engineers, who were employed because their services could be obtained at low rates." Navigation on the Guyandotte revived after the Civil War, but no effort was made to restore the slackwater project.

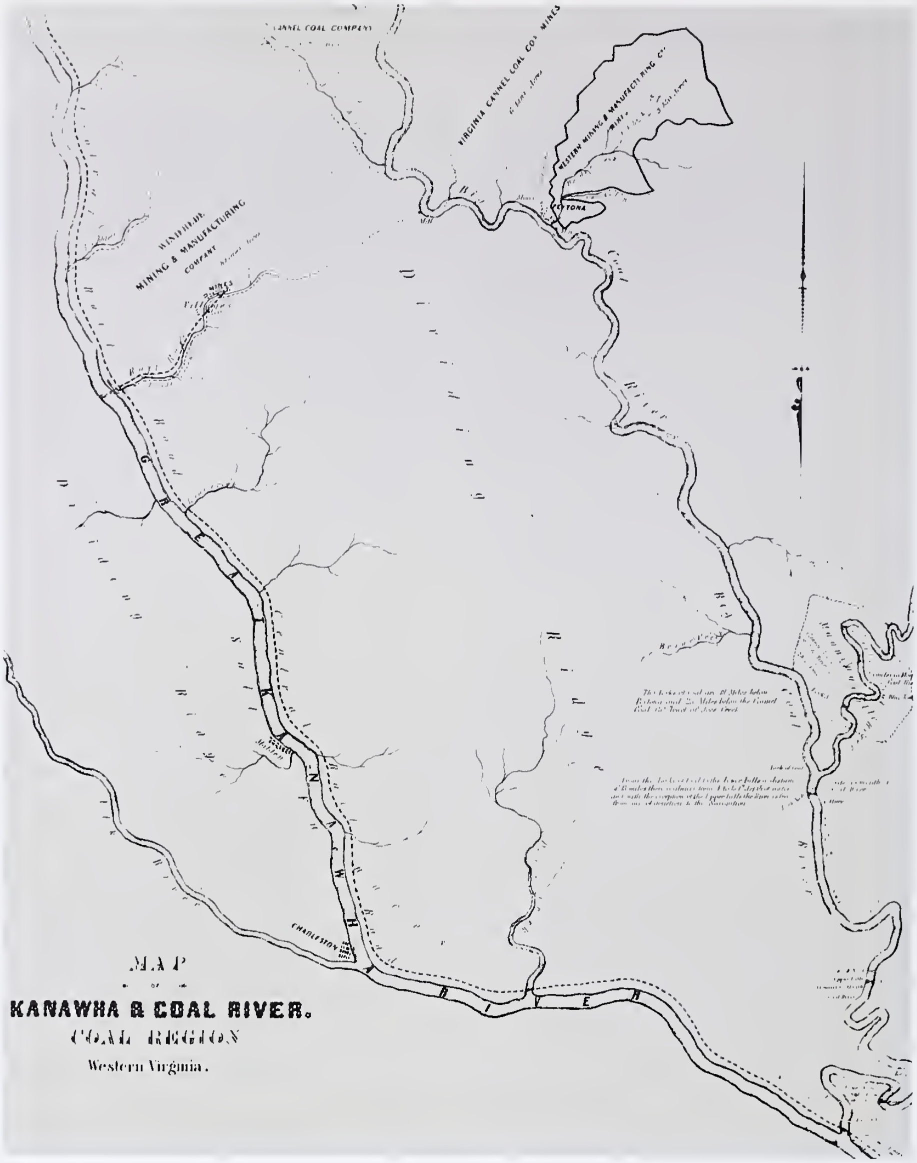
Canalization of the Coal River

The Coal River canalization project had a history similar to that of the Guyandotte project: construction by a private corporation to open access to coalfields and an eventual destruction by floods. Coal River, which empties into the Kanawha at St. Albans, was discovered by Virginians in 1742; they so named it because of the coal they observed along its banks. Over 4,000 flatboats were built along Coal River for sale to the Kanawha salt shippers during the early nineteenth century, but coal was not shipped until 1850, when cannel coal became a marketable commodity. Cannel coal could be refined into illuminating and lubricating oil and paraffin, and William Madison Peyton organized companies to mine the greasy mineral at Peytona on Big Coal and Manningsville on Little Coal about 1848. Peyton acquired a charter for the Coal River Navigation Company from Virginia in 1849 and improved the channel by removing snags and boulders, but he found the cost of shipping the mineral down Coal River on flatboats more than double the cost of mining.

Peyton, Henry DuBois, and directors of other mining companies in the Coal River basin pooled their resources and, with financial aid from the state, planned a slackwater project to permit the use of steamboats and barges in shipping coal from the mines. As project engineer the Coal River Navigation Company employed Captain William S. Rosecrans, former officer of the Corps of Engineers, who had resigned in 1853 to become a consulting engineer.

Captain Rosecrans planned a project to canalize Coal River by construction of eight locks and dams, numbered 1 to 8, to furnish slackwater thirty-five miles up the Big Coal to Peytona and Lock and Dam A on the Little Coal to reach mines along that stream. Construction began in 1855, and the entire project was completed in 1859 at a total cost of $208,975. Like that on the Guyandotte, it was a cheaply built project: the dams were stonefilled timbercribs resting on wooden piles, with thick boards driven down across the upstream sides. The 124- by 23-foot locks were also built of timber cribs, with oak planks driven around their foundations to prevent undermining.

Captain Rosecrans resigned as project engineer after construction began to build a cannel-coal oil refinery in Cincinnati. In this work, Rosecrans performed some of the earliest experiments with oil chemistry, discovering and patenting a process for making soap from oil and inventing the kerosene chimney lamp for home lighting. His oil refinery had just become profitable in 1861, when he left it to lead a Union Army into western Virginia.


MAP
OF
KANAWHA & COAL RIVER.
COAL REGION
Western Virginia.
CANNEL COAL COMPANY
VIRGINIA CANNEL COAL CO. MINES
WESTERN MINING & MANUFACTURING C°
PEYTONA
WINIFREDE
MINING & MANUFACTURING
COMPANY
MINES
CHARLESTON
Coal River
K A N A W H A
R I V E R

—*Library of Congress*

Map of Kanawha and Coal Rivers Coal Region, Western Virginia.

The steamboat *Clifton* passed through the Coal River locks in March 1859 and up the four-foot slackwater project to Peytona, inaugurating Coal River steamboat commerce. Towboats usually left the mines towing two 280-ton capacity barges specially built to fit the locks. On reaching the first lock, a barge was locked through, and then the towboat. While the second barge was being locked through, the towboat took the first barge downriver to the next lock, left it for lockage and returned to the first lock to pick up the second barge, and so on downriver through eight locks. Only the very high price paid for cannel coal made the operation profitable. More than 400,000 bushels of greasy cannel went down Coal River in 1859, and twice that amount went out in 1860. Some was even shipped down the Mississippi to New Orleans and by sea to Boston.

Coal River Navigation Company put a dredge to work on the river channel in 1860 and was planning construction of a ninth lock and dam when war interrupted mining in 1861. The pool behind Lock 1 on Coal River was crowded with loaded barges when the Union steamboat flotilla began its advance up the Kanawha, and the president of the navigation company, who became a Confederate officer, had the barges scuttled, blocking navigation up the Coal. The record flood of September 1861 severely damaged the crude navigation structures on the Coal, but a reorganized navigation company made repairs in 1867, mining was resumed, and coal tows once again shuttled down Coal River. Over a half million tons of cannel coal were shipped down Coal River in the postwar era, but competition from petroleum drove cannel-coal oil from the markets and the Coal River slackwater project was abandoned in 1882. By 1900, little trace of the cannel coal industry, or the pioneer Coal River slackwater project, remained.

Problems of Coal Shipment on the Kanawha

Coal had been shipped in flatboats down the Kanawha River to Ohio River ports as early as 1840, but the trade did not become important until about 1850. Forty-six coal companies began operation along the Kanawha and its tributaries between 1847 and 1860. Some were small firms like the Old Dominion Coal and Iron Company, which suspended operations after losing a single coal-loaded flatboat on a rock in the Kanawha. Others, like the Winifrede Mining and Manufacturing Company, were large concerns, owning many flatboats, barges, and steam towboats and operating coalyards at Cincinnati where coal was stockpiled and sold when the rivers were low and coal prices skyrocketed.

The growth of the Kanawha coal industry was greatly hampered by the hazards and suspensions of navigation on the Kanawha River. Most mining companies which failed before 1860 did so because of the inadequacies of Kanawha River navigation. The dug-chute channels cleared by Virginia for salt-laden flatboats were too narrow for coal barge tows pushed by steamers. Upset by their losses and long interruptions because of low water, Kanawha coal shippers became bitter about Virginia's apparent neglect of the Kanawha navigation project.

Kanawha valley coalmen held a convention at Charleston in 1855. William Rosecrans, representing the Cannel Coal Company of Coal River, and Joseph H. Gill, former state engineer on the Guyandotte project, were present. The convention sent a petition to the Virginia General Assembly to describe the deplorable state of navigation on the Kanawha and the unemployment and economic recessions which low water on the river caused, and to urge the state to take remedial action, permitting the development of "those rich mineral resources of the Kanawha Valley, that have so long languished for want of a reliable communication with the western and southern markets."

The General Assembly responded to these complaints by authorizing the James River and Kanawha Company to borrow funds necessary for further improvement of the Kanawha, but the company was not able to sell its bonds. To placate the western Virginians, the General Assembly established the Kanawha Board in 1858 to administer the Kanawha navigation project.

The Kanawha Board learned that several engineers had studied Kanawha navigation problems and had recommended different solutions, and it employed Charles Ellet, Jr., a well known civil engineer, to restudy the Kanawha navigation project and determine what would be the best method of improving the stream.

After the James River and Kanawha Canal Company dismissed him in 1839 Ellet had traveled widely to study European engineering practices and had achieved a national reputation as a bridge and waterways engineer. He designed the first suspension bridge built in the United States in 1842, and later built a suspension bridge over the Niagara River and the suspension bridge over the Ohio at Wheeling, the longest suspension bridge in the world when completed in 1851. Ellet had also served on many early canal, waterway, and railroad projects, including the Virginia Central (Chesapeake and Ohio) which he opened through the Blue Ridge and into Staunton in 1854.

Ellet was familiar with the plans drawn up in 1828 by William G. McNeil, an Army Engineer, for supplying the James River and Kanawha Canal with water at its summit in the Appalachians by construction of storage reservoirs in the Kanawha basin—on Anthony Creek, Howard Creek, and Meadow River—and while planning the Wheeling Bridge over the Ohio River in 1848 a brilliant idea had occurred to him: Why not build storage reservoirs in river basins to aid navigation during low water seasons, and perhaps even eliminate some of the catastrophic damages caused by floods?

While planning the Wheeling Bridge, Ellet had founded the science of hydrometry (streamflow measurement) to learn how high the bridge should be to avoid damage by floods. He examined old gage records of river stages and learned the Ohio River had plenty of water for navigation every year. Trouble was, the water flowed sometimes in a trickle, sometimes in a flood.

From his computations, Ellet concluded the construction of several large dams on Ohio River tributaries to store floodwaters, to be released when needed for navigation, could even out the fluctuations of the Ohio enough to assure a year-round six-foot depth for navigation. Floods might be controlled and navigation made dependable, and water from the impoundments could power sawmills, flourmills, and all sorts of industry.

Reservoirs for flood control and other purposes became near-obsession in Ellet's mind, and he viewed the idea as his crowning achievement as an engineer. He even named his son Charles *Rivers* Ellet.

Ellet published his reservoir idea in engineering journals in 1849 and launched a personal campaign to get Congress to fund studies and perhaps construction of an experimental reservoir project. He found some support in Congress. Henry Clay thought the idea had much merit and said he believed Ellet's reservoir scheme would ultimately prevail for river improvement. A Senate committee reported in 1850: "In truth, it is difficult to conceive of a plan more simple to execute, or easier to maintain than that which is now offered for the improvement of the navigation of the Ohio. The construction of a few dams will complete the work; the employment of one agent at each dam, and a superintendent for the whole system, completes the outfit."

A bill establishing an engineer commission to survey reservoir sites on Ohio River tributaries failed in the House in 1850, but Congress did approve the first federal study of Mississippi River flood problems and appointed a board of engineers comprised of Ellet, Colonel Stephen H. Long, and Captain Andrew A. Humphreys to perform the study. Ellet submitted his part of the report in 1852, urging early construction of reservoirs for navigation improvement and flood control on the Kanawha and other tributaries of the Ohio, followed by reservoirs to be built in the upper Mississippi and Missouri river basins. Ellet thus became the first engineer to advocate comprehensive river basin planning, employing levees, reservoirs, and floodways, linking navigation improvement to flood control and hydropower production, and requiring federal action because the resources of state and local governments and private enterprise were too limited for so huge a planning and construction program.

Congress again studied Ellet's proposals in 1857, but by that date another equally experienced and renowned civil engineer had examined the Ellet plans and found them wanting.

W. Milnor Roberts, chief engineer of the Monongahela River slackwater project, declared far more dams would be required to control the Ohio River than Ellet thought, that Ellet had not fairly valued the losses of lands and minerals and the costs of moving villages, highways, and railroads in reservoir areas, and that the engineering problems of the reservoir scheme would be far more complex than Ellet imagined.

Roberts said canalizing the Ohio with locks and dams would be more effective and easier to accomplish than the Ellet reservoir plan, noting that slackwater systems were already in operation on several Ohio River tributaries. He warned that the Ellet plan would not be as simple as it appeared on the surface and urged complete studies by practical engineers: "Experience, everywhere, teaches the danger of *merely* legislative decisions of such questions." Congress took a second look at Ellet's ideas in the light of Roberts' objections and rejected the reservoir plan in 1857. The Kanawha Board then employed Ellet to plan a project for better navigation on the Kanawha River.

In his report on the Kanawha in 1858, Ellet recommended construction of a huge stone-masonry dam across Meadow River, a tributary of the Gauley River—which joins New River to form the Kanawha—later to be supplemented by dams and reservoirs on the Elk, Coal, Pocotalico, and other Kanawha tributaries, to reduce flood heights in the Kanawha basin, to furnish greater depths for navigation, and to increase flow in dry seasons to reduce the effects of water pollution.

Ellet believed enough water could be stored in reservoirs to maintain a steady four-foot depth in the Kanawha and raise it to six feet once a week for heavy coal barge navigation. He also recommended widening the dug-chutes through Kanawha shoals to eighty feet, because the old forty-foot-wide chutes carried only about a fourth of the river flow at low water, while the rest of the river spread out over the shallows.

The Kanawha Board, with only limited funds available, did not adopt Ellet's reservoir scheme, but thought the plan to widen the chutes had merit. The board purchased four steam dredges to enlarge the Kanawha chutes and entered into several contracts for building stone wing dams and sidewalls to aid in achieving a channel at least eighty feet wide and four feet deep. The project was disrupted by the onset of war in 1861, and the completed work was badly damaged by the flood of September 1861, when the Guyandotte slackwater project was wrecked and the Coal River locks and dams were damaged.

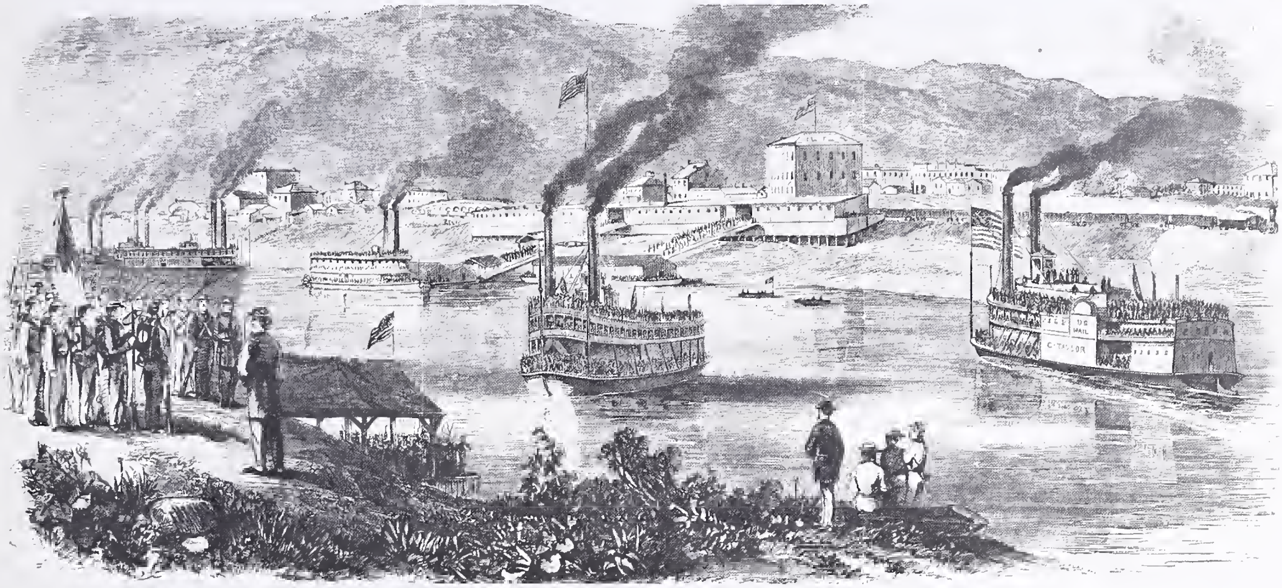
Projects on the Ohio Tributaries Had Measure of Success

Marred by sloppy engineering, the cheaply built projects on the Muskingum, Kanawha, Guyandotte, and Coal rivers required constant repairs and cost far too much for maintenance. The Muskingum project was profitable for about a decade, but because of high operating and maintenance costs Ohio had become anxious by 1861 to be rid of it. The open-channel Kanawha project benefited flatboat and keelboat traffic and permitted light steamboats to navigate the stream, but it was inadequate for heavy coal barge tows. The Coal River slackwater was beneficial only because of the high value of cannel coal; and the Guyandotte River project may have been the worst slackwater system ever built in America.

Nevertheless, each project was built at very low cost and permitted commercial and industrial development which might not have been possible without the improvements. At least many of the residents of the regions where the projects were built thought them worthwhile, and in the years after the Civil War urged Congress to take over the rivers for the United States and to renew work on the navigation improvements in the hope that waterway commerce might continue to function in the national transportation system.

Chapter V

Waterways in the War and After, 1861–1875



—*Library of Congress*

Steamboats carrying troops and munitions of ward for Federal Forces on the Great Kanawha River.

"Service will continue unless interrupted by the Yankees!" said Captain Farley as he boarded passengers and freight on the *Kanawha Valley No. 2*, the weekly Charleston-Cincinnati packet, at the Charleston wharf in May 1861. Service was disrupted on the downbound trip at Gallipolis, where Yankees seized the cargo.

Captain Farley, like many other rivermen, had a bad year in 1861. When the Yankees released his boat, he returned to Charleston, loaded the baggage of the Twenty-second Kanawha Confederates, and steamed up the Kanawha toward Cannelton. Men of the Twenty-second Kanawha Regiment marched along the riverbank toward the same destination and as the *Kanawha Valley* passed they hailed the boat, but Captain Farley refused to put to bank and the Confederates loosed a hail of riflefire at the steamer, killing a passenger. On arrival at Cannelton, General Henry A. Wise, commander of Confederates in the Kanawha valley, ordered the boat burned, and the Confederates put it to the torch at Montgomery, where the charred hull lay for many years, a grim reminder of the price of war.

Holding the Kanawha Valley

General Wise told General Robert E. Lee that he planned to hold the Kanawha valley by controlling navigation on the Kanawha, Coal, and Elk rivers and by extending the Confederate left flank to Barboursville on the Guyandotte and the right flank through Sutton and Summersville to Ripley, thus trapping Union forces advancing up the Kanawha in a pocket. The civil engineers recruited for military service were hard at work on fortifications and had "strengthened us far more than all the militia called out," said General Wise. "We are throwing up breastworks and defenses at every pass, and mean never to be taken."

Across the Ohio River, General George B. McClellan, commander of Union forces in Ohio, laid plans to deal with Wise by sending General Jacob D. Cox up the Kanawha while other Union forces sought to sever the Confederate line of retreat into eastern Virginia. McClellan ordered General Cox to proceed to Gallipolis, occupy Point Pleasant, establish a position at Letart Falls to control Ohio River traffic, punish Confederate garrisons at Ripley, Guyandotte, and Barboursville, and advance up the Kanawha River to reopen its navigation and seize Charleston and Gauley Bridge. General Cox performed as ordered, capturing Ravenswood and Ripley, driving Confederate units from Barboursville and Guyandotte—Guyandotte was burned to the ground—and moving up the Kanawha with a fleet of twelve steamboats.

Though one Union transport was almost lost when it rammed a sunken coal barge in a chute, General Cox reported the trip up the Kanawha was facilitated by the rough wing dams and dug-chutes. Confederate forces temporarily stopped the Union advance at Scary Creek, but Cox resumed his cautious advance upstream, sinking the steamboat *Julia Maffit,* and capturing Charleston on July 25 and Gauley Bridge on July 29, 1861. Cox had several competent Army Engineers on his staff, who fortified the Union position at Gauley Bridge and built a pontoon bridge to provide communication across Gauley River.

Confederate General Wise withdrew from the Kanawha without a major confrontation, bitterly commenting as he left: "The Kanawha Valley is wholly disaffected and traitorous. It was gone from Charleston down to Point Pleasant before I got there. Boone and Cabell [counties] are nearly as bad, and the state of things in Braxton, Nicholas, and part of Greenbrier is awful. You cannot persuade these people that Virginia can or will ever reconquer the northwest, and they are submitting, subdued, and debased."

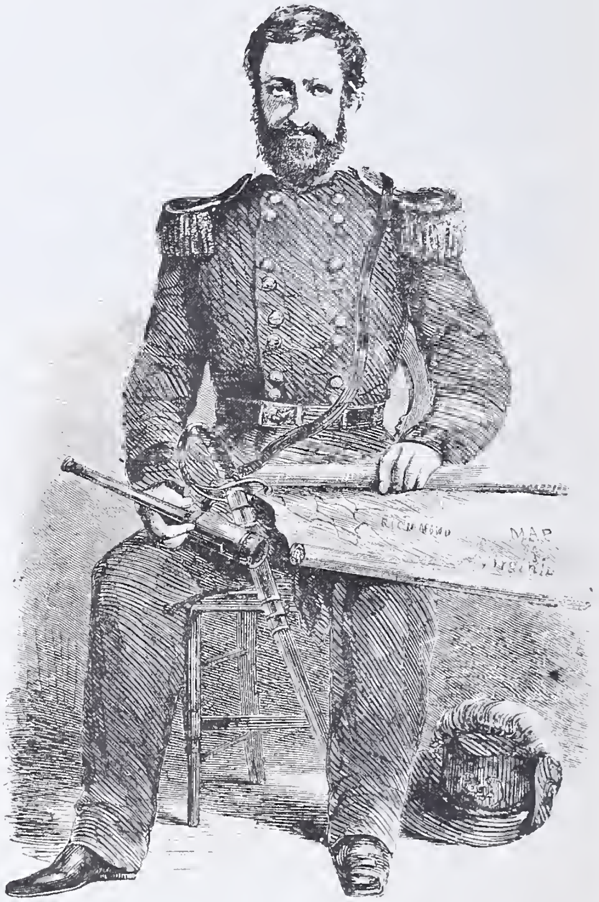
Just as the *Kanawha Valley* was deprived of its cargo by Yankees, then burned by Confederates, the valley for which the boat was named was subject to similar vicissitudes. A resident of St. Albans, at the juncture of the Kanawha and Coal rivers, recalled after the war: "In our town there was strife, neighbor against neighbor, and in some instances the son against the father. The times were awful, and soldiers would shoot at citizens for fun." Confederates made many raids into the region, and Union troops retaliated, and friend often could not be distinguished from foe.

Inland Waterways in the War

Before hostilities began, the Ohio River seemed a clear-cut line dividing North from South, but in fact the waterway tended to unite rather than divide. Virginia State Engineer E. Lorraine, in a passionate appeal to the Virginia General Assembly in 1855 urging construction of the James River and Kanawha Canal, wrote:

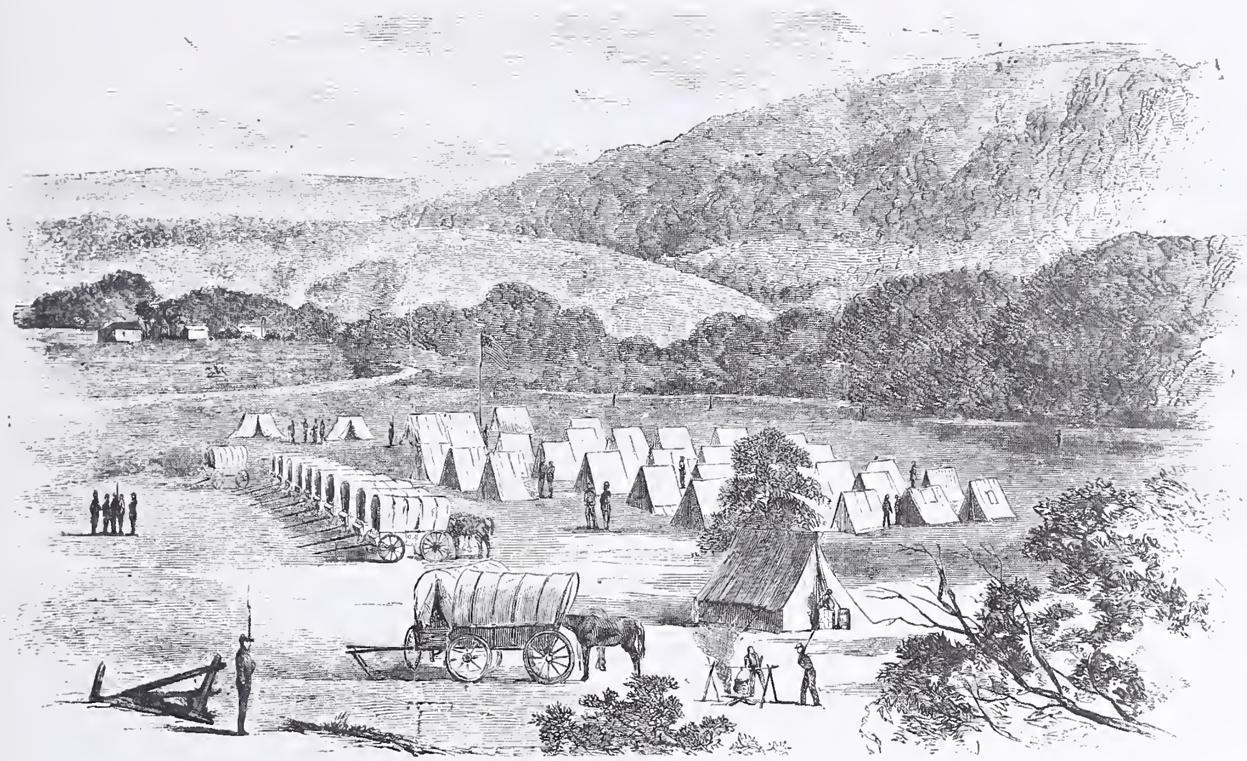
> For want of the means of intercommunication, the people of western Virginia are partially alienated from their brethren of the east. Their trade and commerce is principally with the people of Ohio. They educate their children at Cincinnati. This state of things should not exist. The heart of Virginia should beat with but one pulse, whose throb should be felt from the centre to the utmost limits of the state. As long as the mountain barriers which divide the state are unsubdued by the hand of improvement, so long will there be mountains of sectional jealousy and prejudice unremoved.

The James River and Kanawha Canal was not built, nor was Kanawha River navigation adequately improved, and these circumstances, along with many other considerations, led to the dismemberment of Virginia. Western Virginians organized a new state, at first named "Kanawha," which became the thirty-fifth state of the Union in 1863, after dropping "Kanawha"



—Library of Congress

Brigadier General William S. Rosecrans
He and General George B. McClellan successively commanded Union Armies which secured military control of West Virginia for the Union. Rosecrans was the former Chief Engineer for the Coal River Navigation Project.



—*Library of Congress*

Colonel Tyler's camp, near Summersville, Virginia, scene of the fight of August 26.

in favor of "West Virginia." With the formation of the new state, it became accurate to say that every state bordering the Ohio River remained loyal to the Union, though loyal Southerners were numerous in each state.

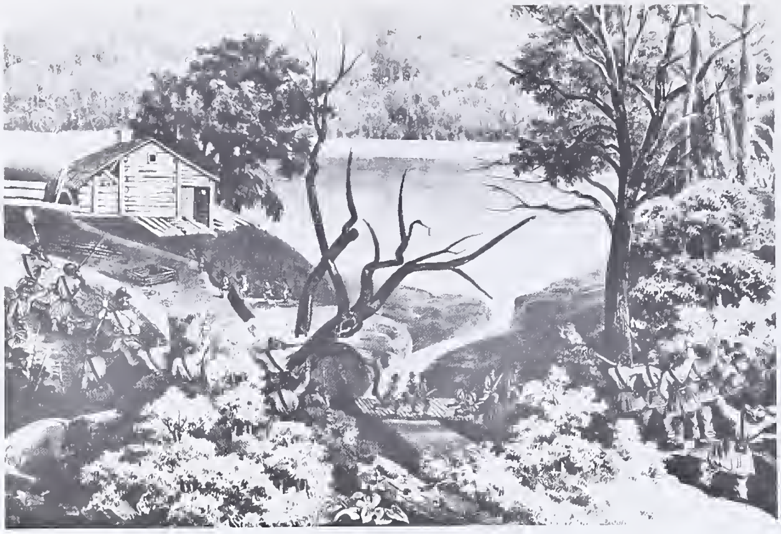
The United States Army Engineers were also divided by war. Colonel Stephen H. Long remained with the Union and became Chief of Topographical Engineers, but his long-time friend and assistant, Charles A. Fuller, joined the Confederacy as Colonel of Louisiana volunteers. Some officers of the U.S. Corps of Engineers resigned in 1861 to join the Confederate Engineer Corps, and others resigned to become Confederate Generals. Robert E. Lee, Joseph E. Johnston, and P.G.T. Beauregard were former U.S. Army Engineers. Among the Engineer officers who became Union Generals were George G. Meade, John Pope, Henry Halleck, George B. McClellan, and William S. Rosecrans.

McClellan and Rosecrans successively commanded the Union armies which secured military control of West Virginia for the Union. Rosecrans, the former chief engineer of the Coal River navigation project, conducted a brilliant campaign in West Virginia in 1861, marching his army across difficult terrain and streams flooded by the heavy rains of the autumn of that year, through Sutton on Elk River and Summersville, near the Gauley, to fall on a Confederate army at Carnifex Ferry.

Events of the Civil War demonstrated the military value of the cadre of Army Engineers, trained during peacetime on civil works projects. The Confederacy had shortages of many things, but its shortage of trained and experienced military engineers was as serious as any other.

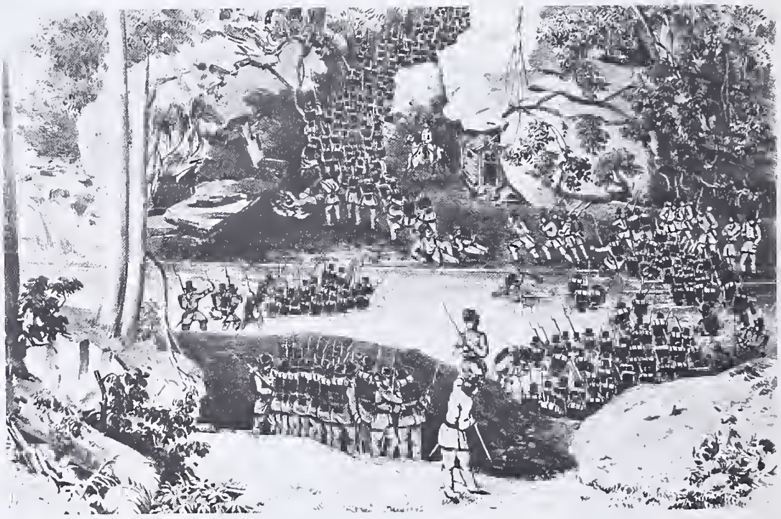
The war also demonstrated the military value of the inland waterways. Every major tributary of the Ohio River from the south served the Union armies of the West as an avenue into the heartland of the Confederacy, and the rivers became the principal supply routes supporting Union military operations. Colonel Stephen H. Long recognized the value the inland rivers could have for Union military operations, and made a special report on inland river navigation in 1861 as Union forces were preparing to penetrate into the South via the Kanawha, Big Sandy, Cumberland, Tennessee, and Mississippi rivers. The greatest depth available for navigation on all inland rivers, except the lower Mississippi, was four feet, the Colonel reported, and even four-foot channels were unavailable most of the year. This fact, he said, should be carefully observed by the men planning and building gunboats "designed for service in the prosecution of the unhappy civil war with which our once peaceful country is now afflicted."

Colonel Long died before the end of the war.



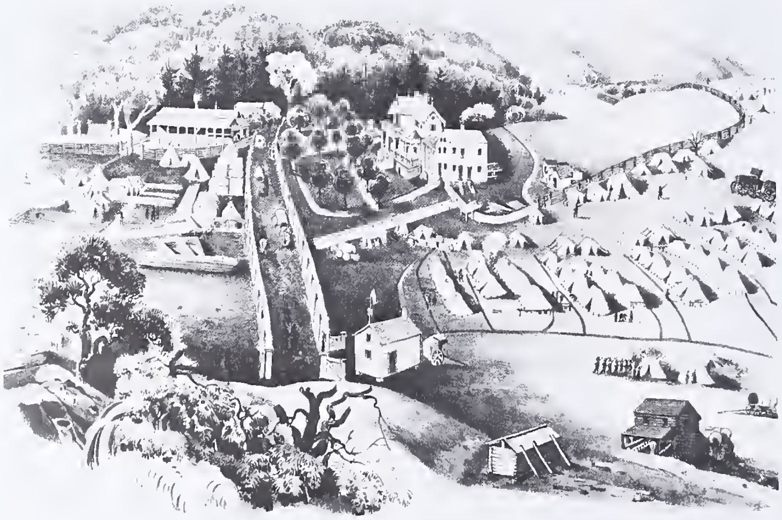
Skirmishing on the New River.

—Library of Congress



Crossing Little Birch River to Bulltown, Virginia (West Virginia) on the Little Kanawha River.

—Library of Congress



Tomkin's farm (Camp Gauley Mount) near where the Gauley and New River forms the Kanawha River.

—Library of Congress

Lithographs, 1862, showing Civil War scenes in West Virginia. Sketched from nature and drawn on stone by J. Nep. Roesler, Corporal of Color Guard Company G, 47th Regiment, OV-USA.

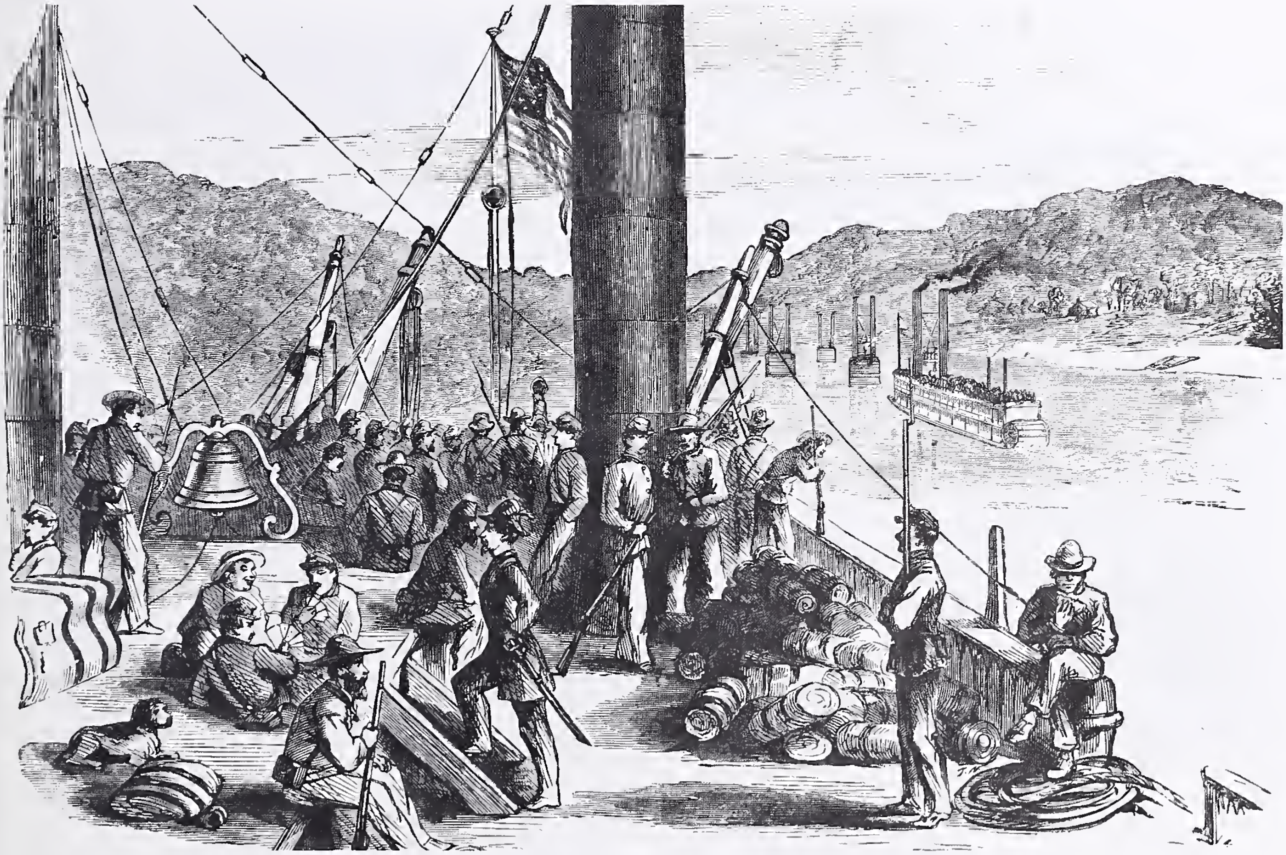
He was the last Chief Engineer of the Corps of Topographical Engineers, for the Topographical Engineers were merged with the Corps of Engineers in 1863 and the Chief of the Corps was thereafter officially the Chief *of* Engineers.

Manufactured goods and farm produce in huge quantities flowed down such Ohio River tributaries as the Muskingum to Ohio River ports, from which supplies were forwarded to Union armies in the field. Even the unreliable Big Sandy River, on the Kentucky-West Virginia border, became a logistical line in early 1862, when Confederate General Humphrey Marshall entered the upper Big Sandy valley through Pound Gap and Colonel James A. Garfield, a Union officer who later became President, moved up the Big Sandy valley to meet him. Garfield loaded troops, mules, and supplies on steamers at Cincinnati, took them to Catlettsburg, at the mouth of the Big Sandy, and thence marched up the valley, with supply boats following. The Union and Confederate armies met in a sharp action at Middle Creek near Paintsville, Ky. in January 1862. General Marshall led his army back to Virginia, but Union supply steamers stopped running when record floods swept down the Big Sandy and its tributaries in late January 1862 and Colonel Garfield found his position at Paintsville becoming untenable.

The Colonel returned to Catlettsburg, commandeered the steamboat *Sandy Valley*, personally took the wheel, steamed upriver while dodging debris sweeping down on the crest of the flood, and puffed into Paintsville with vital supplies. He then moved his army farther up Levisa Fork to Piketon (now Pikeville), and cached his supplies ten feet above the marks of the highest flood of record. Torrential rains fell on February 22, however, and the river rose twelve feet in an hour, nearly sixty feet during the night. Garfield lost his supplies, Piketon was flooded, and two supply steamers were stranded in the town's main street. Despite supply and flood problems, however, Garfield kept his position and held the Big Sandy.

Morgan's Raid

Civil War came to the Muskingum valley by the back door in 1863, when General John H. Morgan



"Harpers Weekly", 1861

Veteran troops moving up the Ohio to Louisville and Cincinnati during the Civil War.

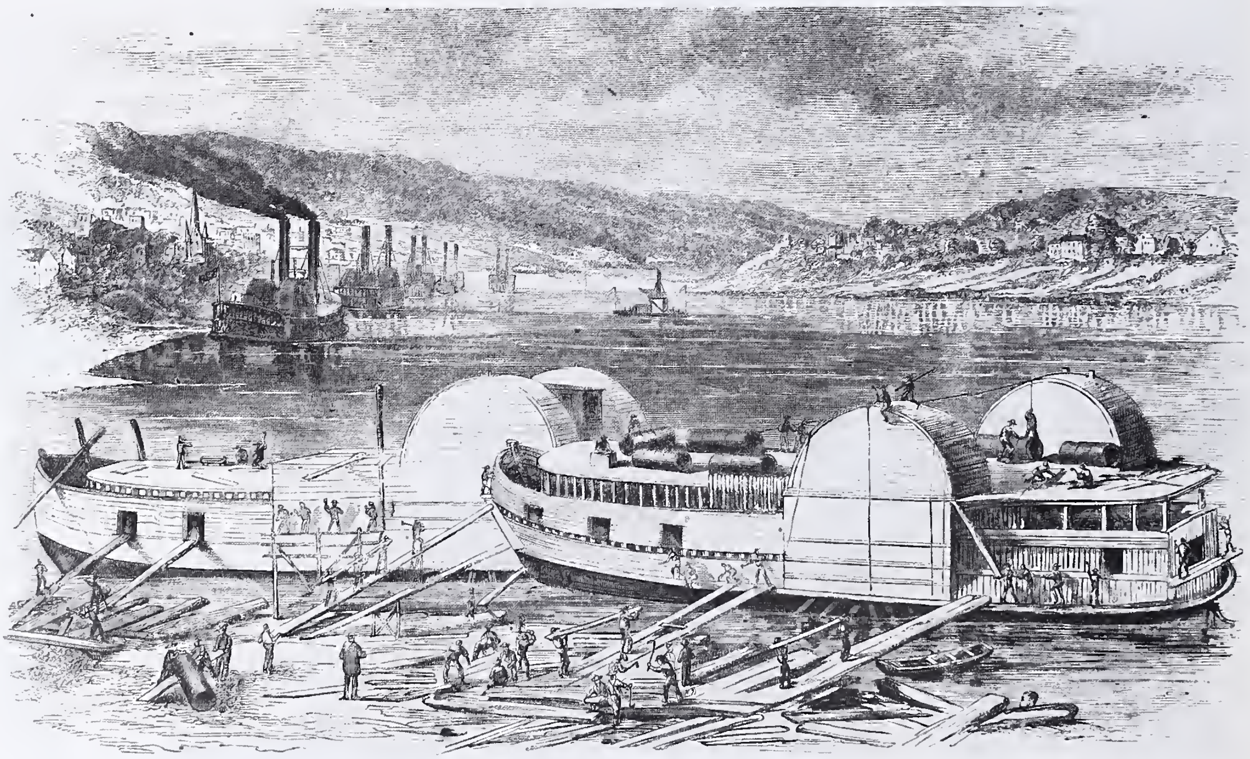
and his Confederate cavalry crossed the Muskingum at Eagleport during a raid through Indiana and Ohio. The little steam ferry *Jesse Edington*, which linked McConnelsville and Malta, was hurriedly transformed into a Union gunboat by mounting the McConnelsville Fourth of July cannon on the bow and loading it with scrap iron. The *Edington* steamed toward Eagleport to intercept the Confederates, but fortunately arrived too late. It was fortunate because on the return trip to McConnelsville the crew of the *Edington* fired the cannon: it merely slid to the rear of the boat, dropping the scrap iron on the deck!

The role of Union gunboats and steamboat transports in the capture of Morgan's raiders was indicative of the role these vessels played on the inland rivers throughout the war. When word of the route of the raiders filtered through to the Union command, gunboats were deployed along the river to prevent the raiders from crossing the Ohio back into West Virginia, and steamboats crowded with soldiers were rushed up and down the river to meet the raiders at every available fording place. Colonel Rutherford B. Hayes (later President) and a Union detachment at Fayetteville (now W. Va.), for example, boarded boats on the Kanawha and moved to Pomeroy, Ohio, to prevent Morgan from crossing. Union troops and gunboats joined in a series of sharp skirmishes to prevent crossings at Buffington Island, Reedsville, and Hockingport; and the Morgan raid ended in disaster, with the capture of the famed cavalryman and most of his troops.

Building the Western River Flotilla

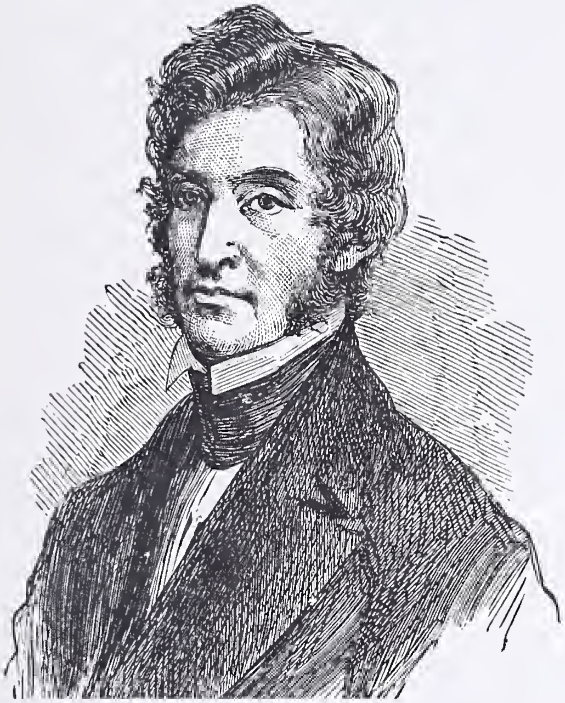
Construction of the western river flotilla, later known as the "Mississippi Squadron," was begun in 1861, when Commander John Rodgers, U.S. Navy, converted several Ohio River steamers into armored gunboats. James B. Eads, the St. Louis engineer who had purchased the Engineer snagboat fleet in 1855, designed and built formidable ironclads for the Union inland fleet at St. Louis and at Mound City, Ill., the latter an Ohio River port. Powerful steam rams, built by Charles Ellet, joined the fleet in 1862.

Ellet had been in Europe during the Crimean War in 1854 and had suggested to the Czar that Russia should build fast steamships with heavy timber-reinforced bows to ram British ships and



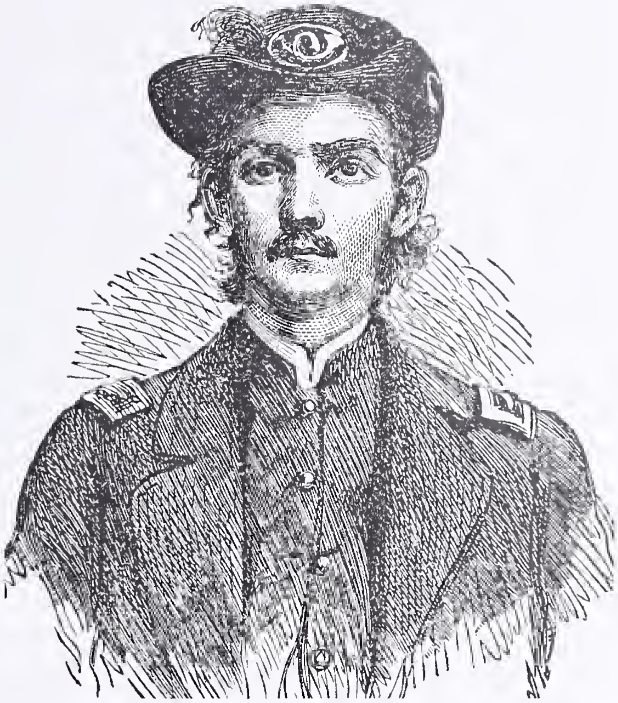
Harper's Pictorial History of the Civil War
Second Part, 1868

Gunboats fitting out at Cincinnati, Ohio. The role of Union gunboats and steamboat transports in the capture of Morgan's raiders was indicative of the role these vessels played on the inland rivers throughout the war.



Harper's Pictorial History of the Civil War
Second Part, 1868

Charles Ellet, a civil engineer was commissioned into the Army to build a ram fleet in 1861. He led his rams into action against Confederate boats.



—Captain Frederick Way, Jr. Photo

Charles Rivers Ellet, took charge of the ram fleet at age 18 after his father's death.

break the blockade of Sevastopol. The Czar rejected this chimerical idea, and so did the United States Navy when Ellet suggested steam rams in 1855. Just another of Ellet's wild schemes, naval officers thought.

But in 1861 the Confederate Navy began building steam rams and there was near panic in Washington. The Secretary of War commissioned Ellet in the Army and rushed him west to the Ohio to build a ram fleet for the river squadron. Ellet converted nine steamboats into rams by strengthening the hulls with timbers. These were fast, unarmed boats—a suicide flotilla—designed to smash into Confederate boats, pierce their hulls below the waterline and sink them. Loss of the ram fleet was expected, but not before destroying Confederate gunboats and ironclads.

Ellet hurriedly completed the conversion, steamed the boats downriver to join the Union gunboats, and led his rams into action against a Confederate fleet at the Battle of Memphis in June 1862. His rams destroyed several Confederate boats at Memphis, proving their value, but Ellet received a fatal wound in the action. His son, Charles Rivers Ellet, accepted the surrender of Memphis, took command of the ram fleet at age eighteen, and led it in several other naval engagements on the Mississippi before he died the following year of disease contracted in the service.

Charles Ellet was probably the most innovative American civil engineer of the midnineteenth century, but his plans often had flaws in practice—his suspension bridge at Wheeling, for example, fell into the river in 1854 and Ellet had to rebuild it. His plans for a comprehensive system of multipurpose reservoirs for flood control, navigation improvement, waterpower production, and pollution abatement on the Ohio and Kanawha rivers were eventually adopted in modified form by the Corps of Engineers in the twentieth century, but the Ellet reservoir scheme presented too many engineering and political problems for solution by nineteenth century engineers and statesmen. Each reservoir in the Ohio basin is, nevertheless, a testimonial to Ellet's original thinking.

No bridge crossed the Ohio below Ellet's bridge at Wheeling during the Civil War era, and huge shipments of munitions and supplies moved on the Ohio upriver to railheads at Parkersburg and Wheeling on the way to the Union Army of the Potomac and downriver to the Union Army of the West. Ironclads, tinclads, monitors, and mortar boats were built by the score at Ohio River shipyards; and hundreds of Ohio River steamboats were pressed into service for military supply.

Though war severed the Ohio valley from southern markets in 1861, waterway commerce began to revive by late 1862 and, because of the stimulus of military supply contracts, the steamboat industry thrived in the last years of the war. By 1865 the Union Quartermaster Department had 262 chartered steamboats in supply service. But navigating the unimproved rivers, often under enemy fire, was hazardous, and 143 steamboats went to the bottom during the war.

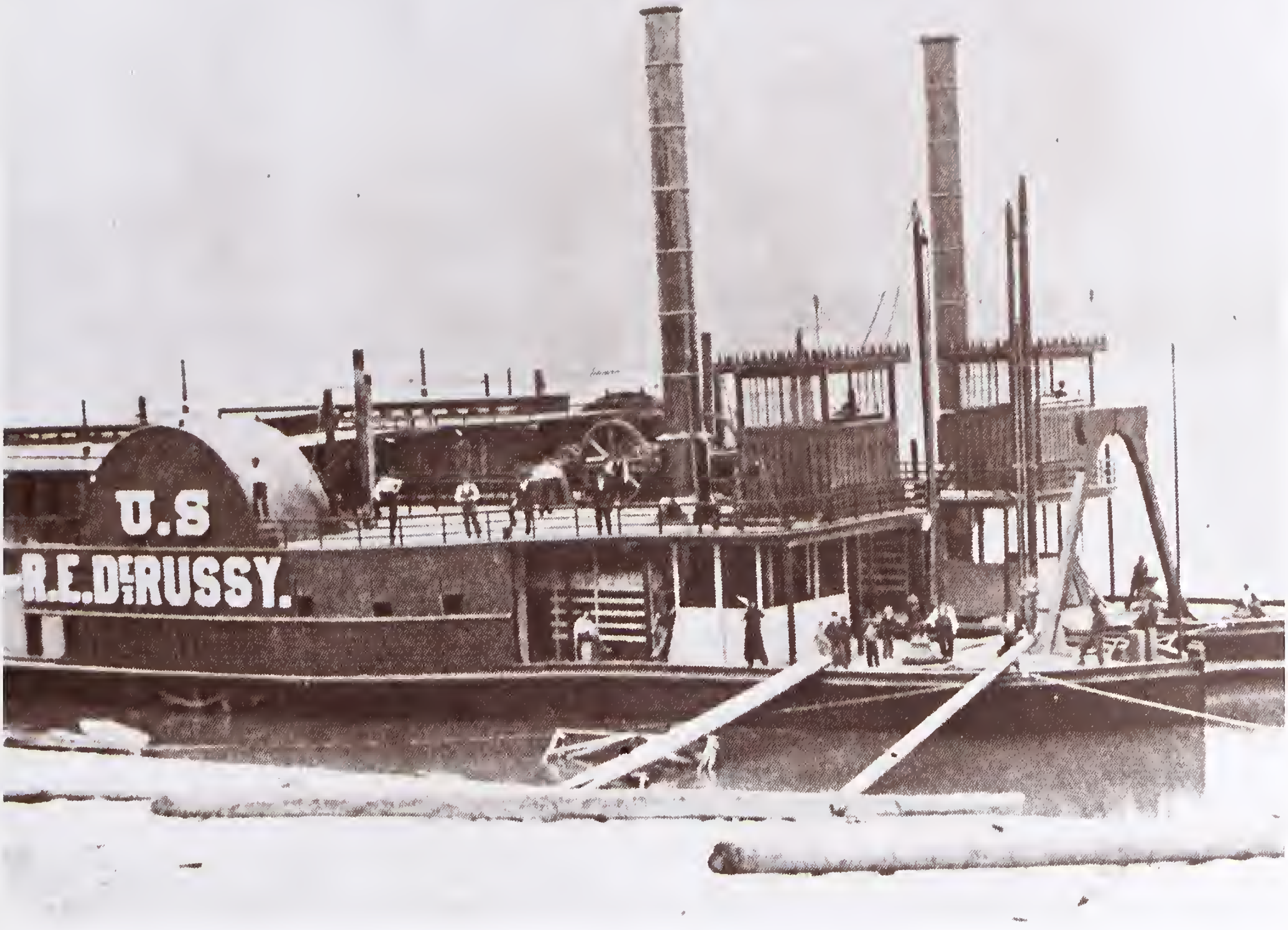
Renewed Interest in Waterway Improvements

Interest in improving waterway navigation revived even before the end of the war. The legislature of the new state of West Virginia passed a joint resolution in October 1863 which called on Congress to improve the inland rivers and requested representatives from West Virginia to support early passage of legislation on behalf of "adequate and permanent" improvement of Ohio River navigation. The West Virginia resolution of 1863 clearly reflected the lessons of war:

> The war prosecuted for the suppression of the existing rebellion, and particularly some of its more recent events have forcibly demonstrated that the safety in time of war and insurrection of several of the States, especially of those

—National Archives

View in 1866 of suspension bridge across the Ohio River at Wheeling built by Charles Ellet. This structure is still standing and listed in the Historical Register.



Howe's Historical Collections of Ohio, Vol. I

Snagboat "R. E. DeRussy".

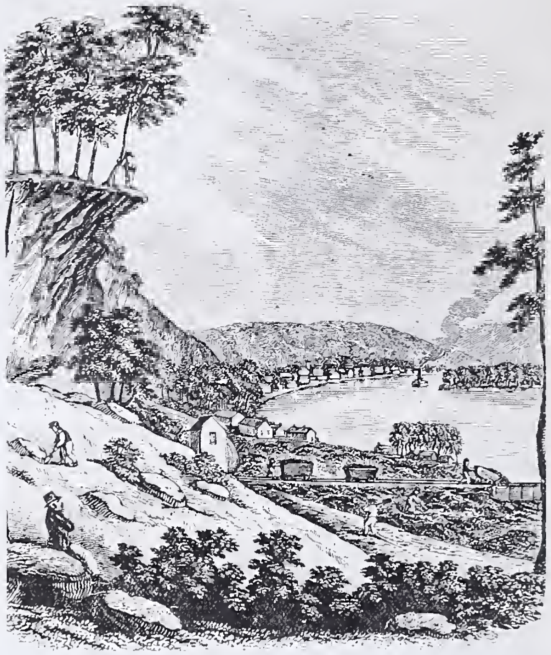
binding on the said river, imperatively demands that the navigation thereof should be so improved and maintained as to place and keep it, at all times, in a condition to permit the free passage, throughout its whole course, of armed vessels, and the easy transportation of troops and munitions of war from point to point on its banks, and between distant sections of the Union.

This and other imperative demands for federal waterway improvements found a receptive hearing in Congress during the postwar years, for with the ascendancy of the Republican party, which favored a positive national transportation policy, and the eclipse of the states rights element of the Democratic party, the constitutionality of federal appropriations for waterway projects was no longer seriously questioned.

Presidents Grant, Arthur, and Cleveland vetoed waterway appropriations bills, but on grounds of expediency rather than constitutionality. Regular appropriations for the improvement of waterways, as recommended by Colonel Long in 1857, began with the River and Harbor Act of 1866 and continued thereafter without much interruption, and the policy of restricting appropriations to interstate rivers like the Ohio and Mississippi ended.

General Richard Delafield, Chief of Engineers, directed examinations of the inland waterways in 1865 and reported to Congress that few permanent improvements had been completed with the meager appropriations of the prewar era. During the decade since Colonel Long had last cleared the channels, snags had accumulated by the thousands, sand and gravel bars had reformed, and the channels had become littered with hundreds of wrecked boats and barges. With funds provided by Congress in 1866, General Delafield established two Engineer offices for inland river improvements: one at Cincinnati under Colonel John N. Macomb to construct a new snagboat

Pomroy, Ohio, from coal mines, 1846.



—*Picturesque America*

fleet, another at Pittsburgh under Civil Engineer W. Milnor Roberts for the Ohio River improvement project.

Colonel John N. Macomb at the Cincinnati office purchased the steamboat *Commodore*, converted it into the wrecking steamer *General J.G. Totten*, and dispatched it down the inland rivers to blast wreckage out of the channels with gunpowder. He then built four huge twin-hull toothpullers, much more powerful than those used before the war, naming them the *S.H. Long*, the *J.J. Abert*, the *R.E. DeRussy*, and the *S. Thayer*, after Engineer officers, and ordered them to clear the inland rivers of the snags which had accumulated since 1856.

After the snagboat construction was completed in 1870, the Cincinnati Engineer office, because the Ohio River improvement project was in charge of W. Milnor Roberts at Pittsburgh, was transferred to St. Louis.

Changed Needs of Commerce Reviewed

When W. Milnor Roberts, the engineer who built the Monongahela River slackwater project and who pointed out the flaws in Ellet's reservoir scheme, was appointed superintendent of the Ohio River project in 1866, he was ordered to examine and survey the river, renew open-channel improvements, and develop plans for "radical" and permanent improvements to navigation.

Roberts chartered a steamboat owned by Commander John Rodgers, employed his son Thomas P. Roberts as assistant engineer, and hired Captain George W. Rowley, former Union gunboat pilot, to assist in the survey. This party set out down the Ohio in late 1866 to determine the condition of the channel and plan renewed work. George Rowley and Thomas P. Roberts updated the Sanders-Fuller maps as they descended the river, while Milnor Roberts investigated river commerce and its requirements. An important trend in waterways navigation was detected. The prewar steamboat-packet passenger and light freight business was declining, but waterborne tonnage was swiftly increasing because bulky commodities, chiefly coal, iron, and petroleum, were being moved by steam towboats pushing barges.

Coal had been shipped down the Ohio as early as 1793 by the Army Quartermaster Department to supply garrisons at forts on the frontier, and commercial shipment to supply river steamers, riverport industry, and steamships and sugar refineries at New Orleans had begun in the early nineteenth century. Coal from the Monongahela River fields first floated down the Ohio in 1814, and David Bradshaw began shipping coal from Pomeroy, Ohio, in 1819.

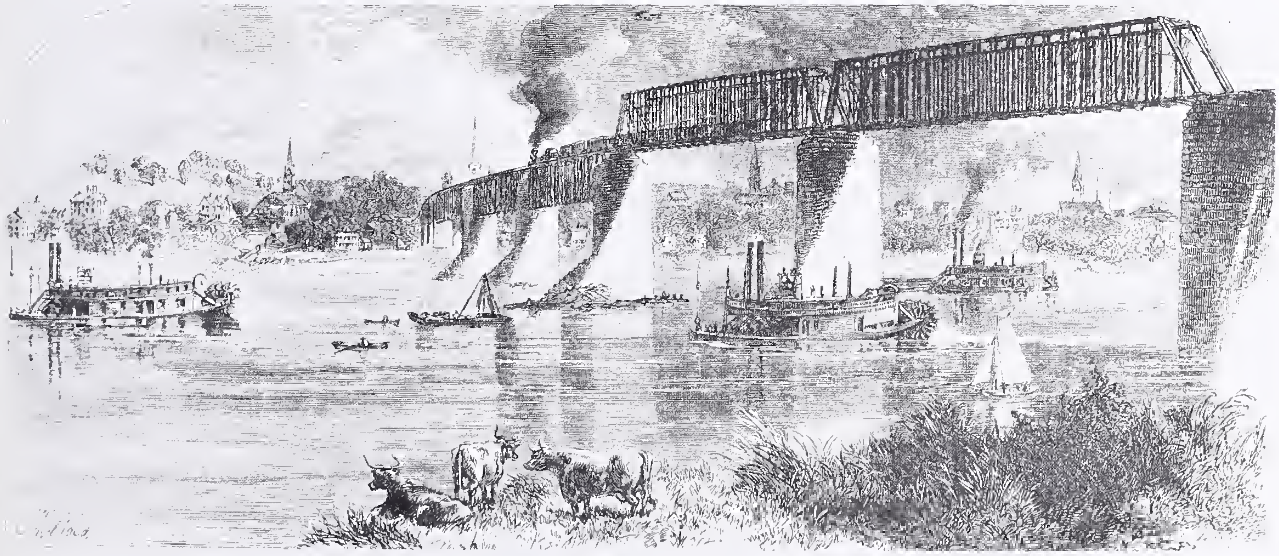
These first shipments were loaded in roughly framed and planked coalboats, resembling flatboats, which were sold along with the coal at destination. The first coalboats were about 80 feet long and 18 feet wide and drew forty inches; they eventually were built up to 175 feet in length and 26 feet wide and drawing eight feet of water when loaded with 24,000 bushels of coal. Coalboats were usually lashed together in pairs and floated downriver at high water stages, steered with long oars very much like flatboats. Coal boating could be a dangerous business—seventy coalboats and seventeen crewmen were lost in an Ohio River storm of 1854, and coalboat losses averaged 10 percent annually. But profits were high.

Milnor Roberts noted in 1866 that coalboats were gradually being replaced by steamboats towing large fleets of coal barges downriver and returning the empty barges upriver for reuse. Towing keelboats behind and at the side of steamboats had been nearly coincident with the introduction of steamboats on the Ohio. Henry M. Shreve towed keelboats loaded with munitions behind the *Enterprise* to New Orleans in 1814, and steamboats plying the Kanawha River commonly pulled keelboats loaded with salt to markets. The steamboat *Condor*, probably the first to tow coal on the Ohio, pushed keelboats lashed alongside from Pomeroy to Cincinnati in 1836. Placing barges ahead of steamboats and pushing them became a common towing method during the 1840's, and to guide barge tows through riverbends the technique of "flanking"—reversing the engines as the tow entered a bend and sliding the towboat crab-fashion toward the bank—was developed to handle large tows. The first Ohio River towboat to deliver coal to New Orleans delivered 2,280 tons in four barges in 1854. But the size of barges, the power of steam towboats, and the number of barges in a tow had increased astonishingly by 1866.

Milnor Roberts reported that, including shipments from Pittsburgh, Wheeling, the Kanawha River, Pomeroy, Big Sandy River, Hanging Rock, and Ashland, forty million bushels of coal (about 1.5 million tons) was shipped down the Ohio River in 1866 and that at least ninety steam towboats were engaged in the coal towing business. Iron manufacturers at Ohio River ports were also shipping railroad iron by barge to St. Louis and bringing back cargos of iron ore. Some bargeloads of petroleum and grain were also seen on the Ohio. Roberts saw the development of the barge towing system as the most important single trend in waterways commerce, and he predicted that, though steamboat packets might survive in local passenger and freight trades, the bulk of commerce on the Ohio would "be ultimately carried on by means of barges towed by steamers."

Improvements Undertaken in Postwar Period

So many snags obstructed the Ohio that they could not be counted, and Milnor Roberts saw 129 wrecked boats and barges in the river. Roberts contracted in 1867 with Commander John Rodgers and his steamboat *Greenback* to begin clear-



Baltimore and Ohio Railroad Bridge at Parkersburg, showing various types of boats on the river. This is typical of many cities on the Ohio railroad and steamboat shipping met to transport coal and other commodities down the river.

Colonel William E. Merrill

"Padre", as he was known to his friends—directed the improvements of the Ohio River and many of its tributaries for over 20 years. He planned and began construction of the Ohio River slackwater project and was acclaimed as the "Father of Ohio River Improvements". President Herbert Hoover expressed his regret that Colonel Merrill had not lived to join in the celebration and dedication of the project in 1929.

William Milnor Roberts

ing the river of snags and wrecks. He also chartered the steamboats *Zebra* and *Petrolia* for the snagging operation. He soon learned, however, that ordinary steamboats lacked the power required for snagging. The *Petrolia* once took four days to remove a single 120-foot "monster pecan" snag, which was so solid it broke both chains and saws. Roberts recommended construction of a light-draft snagboat specially designed for Ohio River conditions.

Roberts had been a close friend of Major John Sanders during the years when Sanders had supervised the Ohio River project and was quite familiar with the work done on the Ohio before the war. In 1866 he found the riprap dams built by Sanders had been covered by sand and gravel and compacted so tightly it took crowbars to pry stones loose from the dams. Roberts first entered into contracts for repair of the Sanders dams, then initiated construction of new dams at such troublesome places for river traffic as Blennerhassett and Buffington islands.

To plan "radical" improvement of the Ohio, Roberts purchased a steamboat, naming it the *Major Sanders*, and sent it downriver under command of Thomas P. Roberts and Captain George Rowley to direct the work of several field survey parties in completing a detailed topographic-hydrographic map of the river. This picked up where the Sanders-Fuller survey ended in 1844 and continued to the mouth of the Ohio. When this survey was completed in 1869, Milnor Roberts recommended permanent improvement of the Ohio throughout its length by construction of locks and dams. He advocated fixed dams, such as he had built on the Monongahela, possibly with movable hydraulic chutes built in to allow coal tows to pass without lockage.

Milnor Roberts resigned in 1870 from the Ohio River project to assist James B. Eads in building the Eads Bridge across the Mississippi at St. Louis; he later surveyed transcontinental railroad routes, served as president of the American Society of Civil Engineers, and at his death in 1881 was Chief Engineer of Rivers and Harbors in Brazil.

In 1870, the man who was to direct the improvement of the Ohio River and many of its tributaries for over twenty years, who planned and began construction of the Ohio River slackwater project, and who was acclaimed as the "Father of Ohio River Improvements," took charge of the Office of Ohio River Improvements.

Known to his friends as "Padre," because of his fondness for foreign languages, great personal integrity, and religious enthusiasm, Colonel William E. Merrill had carried away all class honors at West Point in 1859. He had served with Rosecrans in West Virginia and Tennessee during the Civil War, spent time in a Confederate prison after being wounded and captured while on a reconnaissance mission, developed new mapping techniques and an effective system of railroad defense, and rose to the rank of Colonel. Colonel Merrill served as aide to General William T. Sherman in the immediate postwar years, and then was assigned to river and harbor projects at St. Louis and Chicago, where he began his intensive studies of European and American waterways engineering.

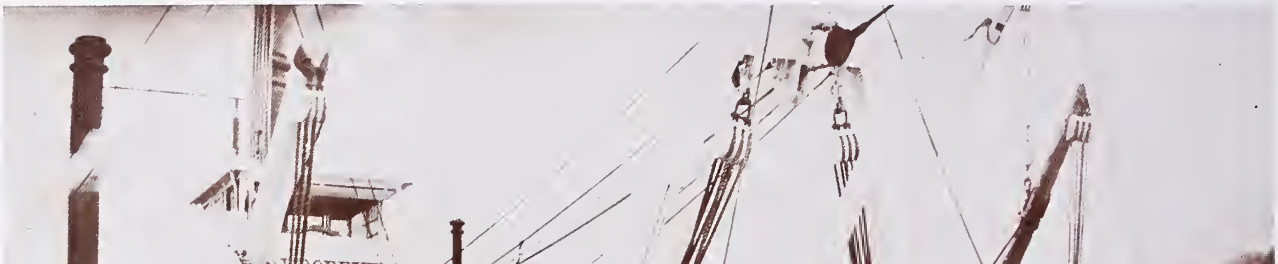
Colonel Merrill established his headquarters at Cincinnati in 1871, founding what was to become the Cincinnati Engineer District, and continued the open-channel methods already in use on the Ohio. He instituted, however, some very important changes in the work.

Congress had required in 1866 that all river improvement work be done by contract, repeating in a sense the mistake made in 1824. Like Milnor Roberts, Colonel Merrill learned that the construction of stone wing dams, where relatively firm specifications could be drawn up for guidance of contractors, could be done by contract, whereas snag clearance and channel dredging under contract was unworkable. Contractors with modified steamboats were unable to handle snags and dredge channels satisfactorily. Some contractors failed, and one even abandoned his contract and fled the country. Merrill therefore sought, and won, approval to construct an Engineer fleet for snagging and dredging on the Ohio.

Merrill's studies indicated that iron hulls might last ten times as long as wooden hulls on boats engaged in hard snagging and dredging service and might result in considerable savings to the government over the years, and he believed that they might encourage the use of iron hulls for commercial boats.

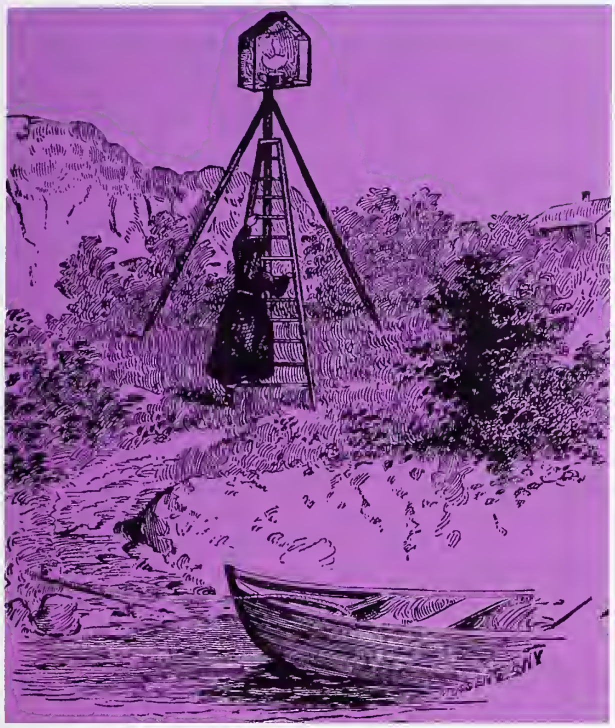
Steamboats with iron hulls had been built at Ohio River shipyards as early as 1839, but because of their high initial cost and the plentiful supplies of cheap timber, rivermen had not viewed iron hulls with much favor. The iron-hull snagboat *E.A. Woodruff*, completed by Merrill for Ohio River service in 1876, was therefore something of an experiment. Single-hull with two bows and a Shreve snag-beam between, the *Woodruff* became a fixture on the river, butting snags over and dragging them out of the water with chains, and ripping and blasting wrecks out of the channel. Under command of Captain George Rowley at first, and Captain William H. Christian after 1879, the iron-hull toothpuller became famous for its ability to navigate the Ohio when all other boats were laid up because of low water. The Engineers used the *Woodruff* on the Ohio until 1925, then sold it to a company which used the hull as a wharfboat until 1940.

Merrill built two steam dredges for the Ohio



—*Howe's Historical Collections of Ohio*

U.S. snagboat "E. A. Woodruff" became a fixture on the Ohio River. The iron-hulled boat was used to butt snags over, drag them out of the water with chains and also to rip and blast wrecks out of the water.



A few beacons were installed in 1866 by Ohio River pilot associations, and 150 beacons and bouys were placed in 875, after a strong recommendation to Congress from Colonel Merrill.

River project, in 1872 and 1874, naming them the *Ohio* and the *Oswego*, and put them into operation under command of Assistant Engineer E.J. Carpenter, who found each dredge capable of moving 1,900 cubic yards of compacted gravel in a single day. The dredges operated at such low cost as compared with contracting equipment that they saved the United States their entire cost of construction in the first two years of operation. Iron hulls were added to the dredges in 1880 and 1882. Both were still in use a century after construction—the *Ohio* as a wharfboat, and the *Oswago* still dredging for a contractor on the Monongahela. Colonel Merrill and his staff built better boats than they ever knew, for the boats far outlasted their builders.

Colonel Merrill also launched a campaign that was taken up by rivermen and carried to Congress for the installation of beacons and buoys to mark river channels. Until 1874, river pilots relied on recognition of striking landscape features—bluffs, lone trees, farmhouses, islands—for guidance, and, in effect, memorized the river channels, as apprentices to older pilots. Milnor Roberts recommended use of beacon lights at shoals in 1866; and Ohio River pilot associations, at their own expense, installed and maintained a few beacons at the more hazardous shoals. Merrill, in a report in 1871, strongly urged Congress to provide for the installation of beacons and buoys on the Ohio River. Rivermen lent their support to the idea, and Congress in 1874 extended the jurisdiction of the U.S. Lighthouse Board to inland rivers. About 150 beacons and buoys were placed along the Ohio in 1875. By 1920 the Lighthouse Board, of which Corps officers usually were members, had 503 signal lights and daymarkers in service on the Ohio and 173 on tributaries. Maintenance of these aids to navigation was turned over to the U.S. Coast Guard during World War II.

Merrill learned in his studies of European waterway projects that efforts to improve open-river navigation by concentrating waterflow had seldom been satisfactory, and he found that when one bar or shoal on the Ohio was improved rivermen instantly found another to complain about. Funds were never sufficient to improve all the bars at once. Open-channel improvements did benefit river traffic, permitting increased payloads and lower marine insurance rates, but Merrill concluded that "in such a river as the Ohio, whose summer supply dwindles down to almost nothing, no radical improvement is possible by mere concentration." He reported in 1875 that, at the most, open-channel improvements might furnish a minimum navigable depth of two feet from Pittsburgh to Huntington, two and a half feet from Huntington to Portsmouth, three feet from Portsmouth to Louisville, and three and a half feet below the Falls of the Ohio.

Railway and Waterway Combine to Make a City

It is notable that Colonel Merrill included Huntington as one of the more important Ohio River ports in 1875, for the city was then only four years old. But in four years it had become an important river terminal. Founded in 1871 at the west terminus of the Chesapeake and Ohio Railroad, across the mouth of the Guyandotte River from Guyandotte, Huntington, like Wheeling and Parkersburg before it, became a boom town because river packets and towboats made connection with the railroad for freight transshipment.

The combination of river and rail traffic, which was to make Huntington the greatest inland riverport in the midtwentieth century, was the principal reason for the quick growth of the city. Just after completion of the Chesapeake and Ohio to Huntington, the Ohio and Kanawha Coal Company, which had been shipping coal down the Kanawha and Ohio rivers to Cincinnati, switched from the hazardous Kanawha River to the C. &

O., shipping coal to Huntington for transfer to coal barge to continue to Cincinnati; the railroad dredged a harbor on the Huntington riverfront for barge loading.

A fleet of large steamers began a regular schedule in 1872 between Pittsburgh, Huntington, and St. Louis, hauling grain shipments from St. Louis and iron products from Pittsburgh to the railhead at Huntington. Such steamboats as the *Ella Layman* also began towing barges of petroleum from the upper Allegheny River to Huntington for rail shipment east—twenty-four tows, with a total of 263,000 barrels of oil, arrived at Huntington from the Allegheny River in 1877. These developments at Huntington made it apparent to Colonel Merrill in 1875 that the river barging commerce might be stimulated instead of hampered by railroad construction.

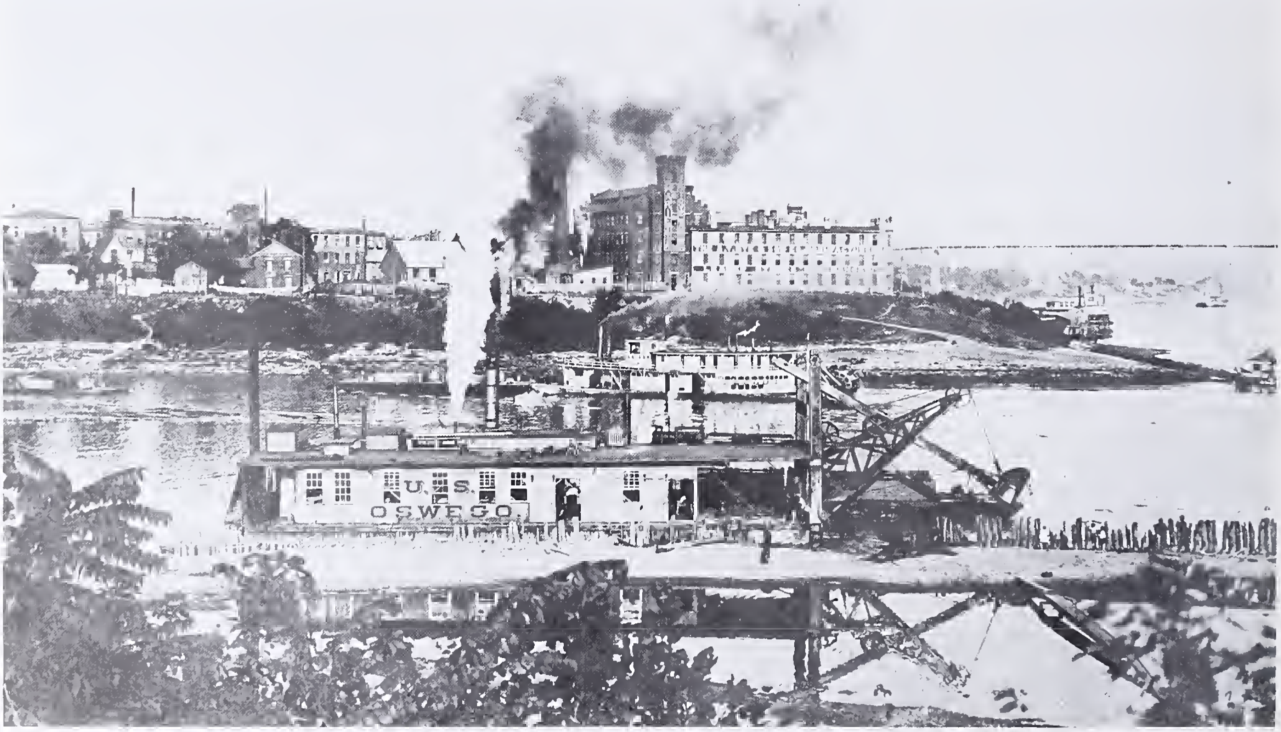
Funding Urged for Central Water Line

In planning the permanent improvement of Ohio River navigation by locks and dams, Colonel Merrill had to consider the historic steamboat packet traffic, the swiftly growing towboat-barge movement and the James River and Kanawha Canal proposal, for Congress was giving serious consideration to construction of the canal as a federal waterway project in 1875.

During the 1870's, rivermen, farmers, business leaders, and state governments in Virginia and Ohio valley and Great Plains states were all urging Congress to fund construction of the James River and Kanawha Canal.

Leaders of the Grange, a farm organization with much political influence—it had a membership in West Virginia equal to a sixth of the voters in the state—were convinced that unfair monopolistic railroad practices were hampering American agriculture, with high transportation costs reducing the American share of foreign markets. The Grangers accordingly supported vigorous federal action to curb the railroads and to improve the waterways. The Grange supported the Central Water Line, involving improvement of Ohio and Kanawha river navigation and completion of the James River and Kanawha Canal to open an all-water route from the Mississippi valley to the Atlantic Coast.

National commercial conventions meeting in the Ohio valley in 1869 and 1870 urged Congress to fund the Central Water Line. In 1870 the legislatures of Virginia, West Virginia, and Ohio resolved that Congress should approve construction of the waterway-canal project, and in 1872 the legislatures of Kentucky and such western



—*Robert E. "Bob" Kennedy Photo*

U.S. dredge "Oswego" working at the mouth of the Muskingum River at Marietta, Ohio.

grain-producing states as Kansas and Iowa lent their support to the project.

Ohio valley states in 1872 organized the Ohio River Commission, with thirty-five members appointed by state governors, to begin a campaign in support of Ohio and Kanawha navigation improvement in conjunction with completion of the James River and Kanawha Canal.

Congress responded to the public and political demands by authorizing a survey of the canal section of the Central Water Line in 1870. General William P. Craighill, the Engineer officer in charge of the James River navigation project, from the Baltimore Engineer office, made the examination of the Central Water Line to the mouth of the Kanawha River, while Colonel Merrill at Cincinnati studied the improvement of the Ohio River as the western section of the proposed Mississippi-to-Atlantic water route.

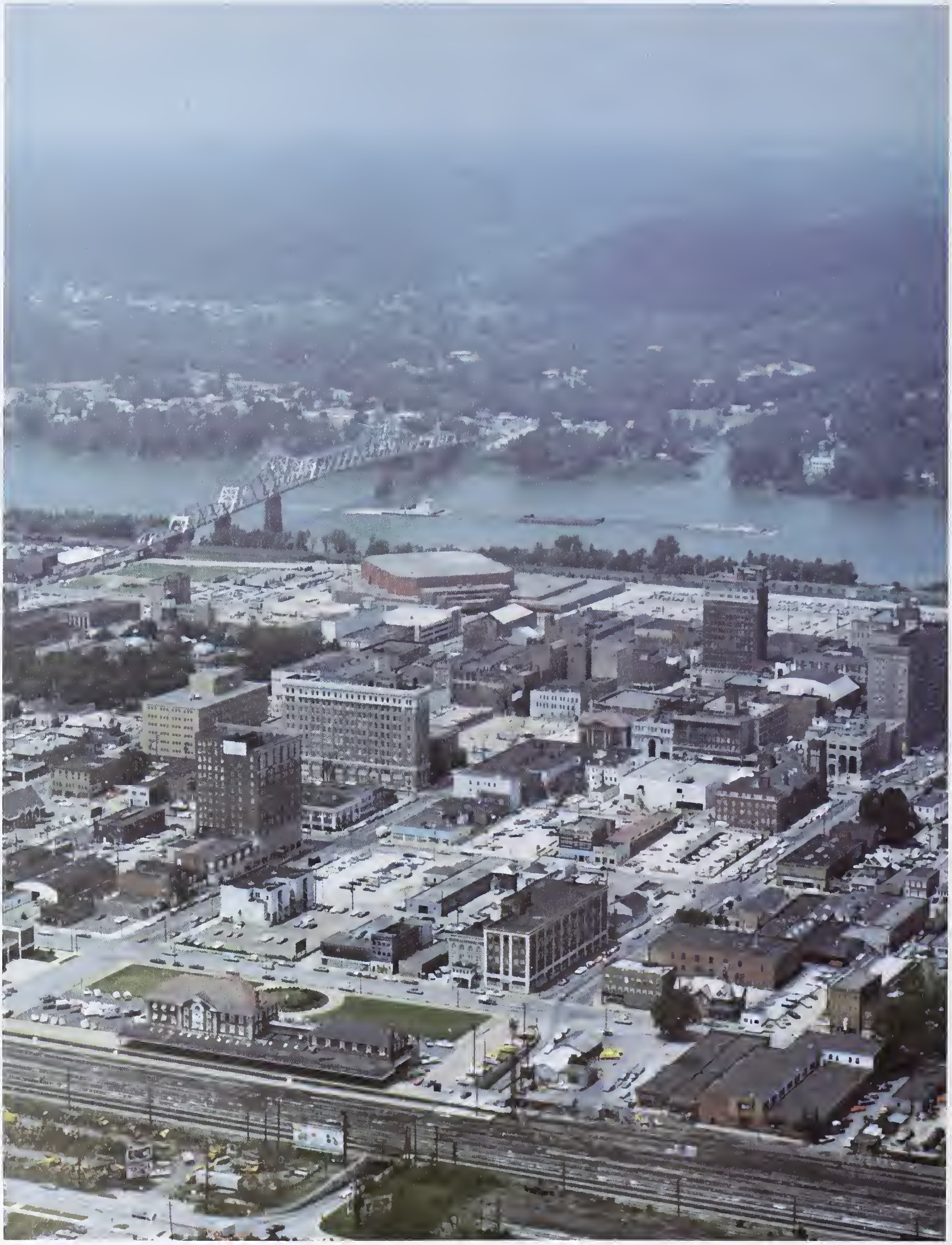
A select committee of the United States Senate, known as the Windom Committee after its chairman, Senator William Windom of Minnesota, began hearings on national waterway transportation needs in 1873, and both General Craighill and Colonel Merrill testified before the Windom Committee in meetings at Richmond, Charleston, and Cincinnati. General Craighill declared his studies revealed the construction of a canal from the James River to the Kanawha and the improvement of Kanawha River navigation was entirely practicable. Colonel Merrill testified that a project to establish a dependable six-foot slackwater depth on the Ohio was feasible and necessary, whether the James River and Kanawha Canal were constructed or not.

In its landmark report of 1874, the Windom Committee urged the construction of three waterways from the Mississippi valley to the Atlantic: the *Northern Route*, involving use of the Great Lakes and the Erie Canal; the *Southern Route* extending up the Ohio and Tennessee rivers, over the southern Appalachians by canal to the rivers of Georgia, and down those rivers to the sea; and the *Central Route*, including canalization of the Ohio and Kanawha rivers to establish slackwater navigation and construction of a canal over and through the Appalachians to the James River and Richmond. The Windom Committee proclaimed the Central Water Line "would develop vast resources of coal and iron, now almost worthless for lack of the means of transportation. It would form a connection between the tidewater at Richmond and 16,000 miles of inland navigation by the Kanawha and Ohio Rivers, and open a cheap and valuable channel of transport to the Atlantic coast for the cereal products of the West."

Despite the loss of some passenger and light-freight traffic to railroads, the growth of the inland river barge-towing system in the post-Civil War years made prospects bright for inland waterways commerce. Congress authorized the canalization of the Ohio and Kanawha rivers to achieve a six-foot depth for navigation, and the Ohio and Kanawha slackwater projects were thus begun in 1875 as units of the proposed Central Water Line. This solved several political problems for Congress: it committed the United States to two worthwhile waterway projects without necessarily requiring construction of the controversial canal to the James River.

But the problems of Colonel Merrill and General Craighill were just beginning, for the canalization projects required some very sophisticated engineering never before attempted in the United States.

Steamer "Potomac" landed at Huntington in 1873, and loaded three C&O Railway box cars.



Railway and Waterway combined to make a city in 1871.

Chapter VI

Ohio and Kanawha Canalization, 1875-1901

Dr. John P. Hale, a Renaissance man of many interests, made a fortune before the Civil War by manufacturing salt and shipping it down the Kanawha, organized Hale's Confederate Artillery in 1861, returned to Charleston at the close of the war to renew his river transport business, and opened Hale House hotel in Charleston. His humor was reflected in the names of his steamboats, *Lame Duck*, *Wild Goose*, and *Here's Your Mule*, which ran for years on the Kanawha and Elk rivers; his experimental bent was indicated by the facts that his *Wild Goose* had the first boiler built by Ward Engineering Works of Charleston and Charleston had the first brick-paved streets in America, thanks to a paving method devised by Hale in 1874. Hale served on the Kanawha Board and represented West Virginia on the Ohio River Commission. He was also handy with a pen and wrote some of the best histories of the Kanawha region; but after the ten lock and dam structures on the Kanawha River were completed Hale wrote a history of the project in which he concluded:

> It is pleasant to record what is quite a remarkable fact in connection with the construction of this great work, that in the more than a quarter of a century it has been under way, there have been no serious accident, disaster, loss or damage to the works by high water, low water, ice or storm; no strikes among laborers, no quarrels or misunderstandings with contractors and others, no friction with the public; everything has progressed quietly, smoothly and pleasantly from beginning to end.

Beautiful, almost poetic. But not a word of it true. Perhaps in comparison with the Ohio River canalization project, where during the same quarter century only a single lock and dam structure was completed, the Kanawha project did proceed smoothly—or perhaps unpleasant memories had faded. Nevertheless, there were accidents and damages, there were strikes and quarrels, there was considerable friction. And no one knew this better than Addison M. Scott, the Kanawha River Engineer who, after devoting twenty-eight years of his life to the project, was fired!

Addison Scott, just after his graduation from Ithaca Academy in New York, was employed by the Corps of Engineers as assistant to Henry Clay Long (son of Colonel Stephen H. Long) and Colonel William E. Merrill on the Upper Mississippi River project in 1867. Colonel Merrill admired Scott's quiet efficiency, and when Congress first appropriated funds to improve Kanawha River navigation in 1873 Merrill asked Scott to become his assistant in immediate charge of the Kanawha. Scott established an Engineer office at Charleston in June 1873, installed water gages along the Kanawha to acquire reliable streamflow data, and began a survey of the river.

Scott found the Kanawha Board was clearing the old dug-chutes and dredging channels

Addison N. Scott

Appointed as Colonel 'Merrill's assistant in immediate charge of the Kanawha in 1873

General William P. Craighill

Officer in charge of the Kanawha River Project in August 1874. He became Chief of Engineers 1895.

through bars with the steam dredges *Samson* and *Hercules*. The board had begun efforts to create a channel eighty to a hundred feet wide and four feet deep in 1858, but war had interrupted the work. The new state of West Virginia reestablished the Kanawha Board in 1863, authorizing it to issue bonds and collect tolls to fund river improvement, but after a decade of work on the Kanawha it had become clear that dug-chutes and dredging could not serve coal barge tows. John P. Hale, a member of the Kanawha Board, said the coalfields along the river were almost valueless because of the lack of "safe, reliable, and economical transportation to market."

The first federal appropriation for the Kanawha, in 1873, was only $25,000, and Colonel Merrill and Addison Scott agreed the funds were insufficient to begin construction of locks and dams. Accordingly, Scott cooperated with the Kanawha Board in widening chutes and building new wing dams to increase depths over shoals. Cooperation between the Kanawha Board and the Corps of Engineers continued until 1883, when the board, having collected sufficient tolls to retire its bonds, turned its dredges and equipment over to the Corps and passed out of existence.

Planning for the Central Water Line

Colonel Merrill transferred the Kanawha River project to General William P. Craighill, Engineer officer at Baltimore responsible for the James River and Kanawha Canal, in August 1874.

General Craighill had had long experience on waterway projects and military construction. A Virginian, he had remained in the Union Army in 1861 at the advice of General Winfield Scott, but he refused to accept field command or to be placed in a position where he would have to fire at his friends in the Confederate Army. Craighill spent most of the war building fortifications. He fortified Cumberland Gap in southeastern Kentucky in 1862, and in 1863 he guided a Union army out of a Confederate trap in an epic escape and march from Cumberland Gap across Kentucky to Greenupsburg on the Ohio River. For this service he was given brevet rank, but he rejected the honor. General Craighill and Addison Scott became close friends, and except for temporary absences on other duties Craighill directed Scott's work on the Kanawha until appointed Chief of Engineers in 1895.

Craighill and his assistants, William R. Hutton and Lieutenant Thomas Turtle, finished detailed surveys and planning for the Central Water Line in 1874. Their plans called for construction of twelve lock and dam structures, to furnish six-foot slackwater navigation on the Kanawha up to the Falls, about 95 miles upstream, and for building canal and slackwater sections from the Falls of the Kanawha up New and Greenbrier rivers, through the crest of the Appalachians by tunnel, and down the James River valley to Richmond. They envisioned canalboats loaded with Midwestern grain on the Missouri and Mississippi rivers, with petroleum on the Allegheny and Little Kanawha rivers, and with West Virginia coal being towed in fleets by steamboats via the Ohio River to the Kanawha and up the Kanawha and New rivers to a basin on the Greenbrier River where the tows would be broken up. Horses would tow the canalboats through a 52-foot wide, 7.8-mile-long tunnel and down the James River Canal to Richmond.

Rivermen Oppose Improvement of the Ohio

Plans for the Central Water Line presupposed improved navigation on the Ohio River, but Colonel Merrill hit a snag on the Ohio project. River captains and navigation interests opposed improvement of the river! Rivermen at Pittsburgh organized torchlight parades to demonstrate their opposition, spread rumors that locks and dams on the Ohio would increase flood heights, would create filthy stagnant pools, and might even cause epidemic disease. The real reason for the opposition at Pittsburgh was that rivermen there were profiting from the business of guiding the immense tows of coal barges to downriver markets and were opposed to any project that would obstruct the channel with dams and require barge tows to be broken into sections to lock through.

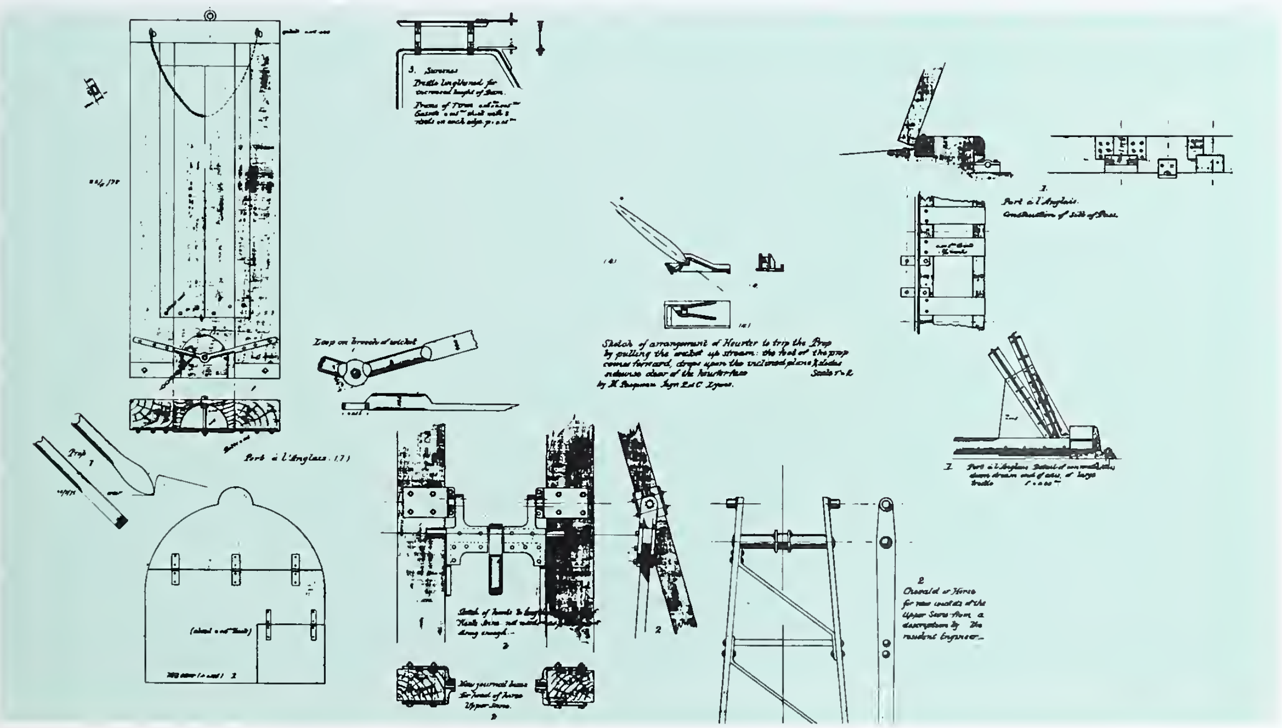
Colonel Merrill proposed locks 600 feet long to accommodate large barge tows and designed a new type of lock gate to permit construction of 110-foot-wide lock chambers—the widest in the world and wider even than the Panama Canal locks built forty years later. Lock gates used in 1875 on private and state slackwater projects like those on the Muskingum and Coal rivers were wooden mitering gates with two leaves operated like double doors, but wooden mitering gates would never work in a lock only about ten feet high and 110 feet wide it was physically impossible. Colonel Merrill designed a rolling gate with wheels that rolled on tracks like a railroad car. From a recess on the landside of the lock, the Merrill rolling gates moved out along the tracks to close the lock chamber and back into the recess to open it.

The huge lock chambers did not satisfy Pittsburgh coal shippers, however, who demanded an open channel for maneuvering their giant coal tows. The coalmen preferred no project at all to the construction of locks and dams.

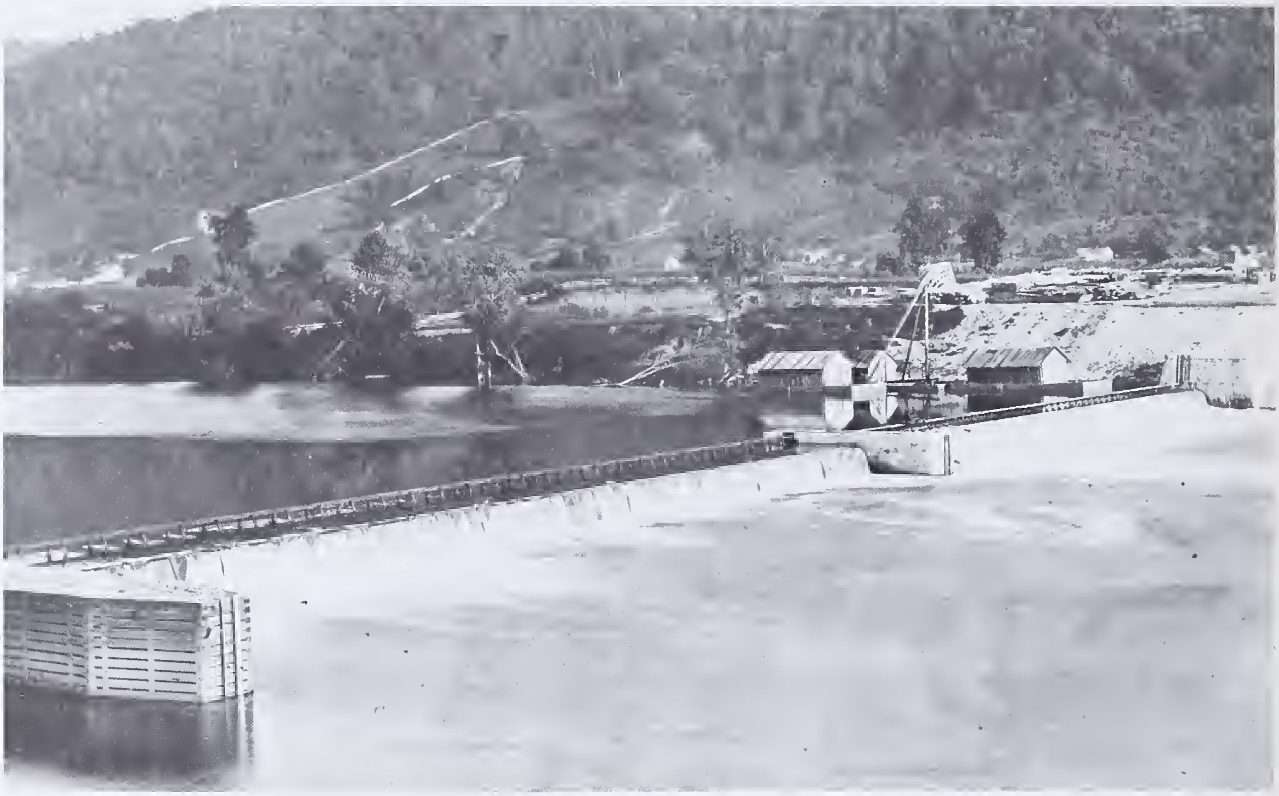
In his studies of European engineering, Colonel Merrill had learned that the French Corps of Engineers was building movable dams that could be lowered to the bottom of the river at high water stages, making possible navigation over the dam. Merrill, General Craighill, William R. Hutton, and Addison Scott traveled to France to inspect examples of the 124 movable dams French Engineers had in operation.

They were surprised to learn that French movable dams had evolved from a dam built on the Lehigh River in Pennsylvania in 1818. Josiah White of Lehigh Navigation Company had invented a movable dam called a "beartrap" to create artificial rises on the Lehigh for navigation. The beartrap dams on the Lehigh had been abandoned and movable dams had been largely forgotten in the United States, but French Engineers picked up the idea, built beartrap dams on the Marne River, and began experiments that led to the elaborate movable dams the American Army Engineers saw on French rivers in the 1870's.

The Americans especially admired the movable dams in use on the Seine River near Paris, a type invented in 1852 by Jacques Chanoine, Chief En-


Port à l'Anglais.
Construction of Sill of Pass.
Sketch of arrangement of Heurter to trip the Prop by pulling the wicket up stream: the foot of the prop comes forward, drops upon the inclined plane & slides sidewise clear of the heurter

Early engineering drawings for locks and dams.



Old Lock and Dam No. 4 on the Great Kanawha River.

gineer of the French Corps. Chanoine dams consisted of a masonry foundation level with the riverbottom, to which long boards known as wickets were hinged. When the wickets were down, lying flat on the foundation, boats passed over them through an open channel called a navigable pass. When the river began to drop, threatening to stop navigation, men at the dam dropped a grapple into the river to catch the handle at the top of each wicket and pull it up. As each wicket was raised, a prop attached to its backside slid up a slot in the foundation and when the wicket was released the prop held it in a near vertical position. Wickets were raised one by one until a row of them, resembling a line of ironing boards on end, closed the channel and backed up water to form a slackwater pool. While the river was low, boats traveled the slackwater pools and were moved from pool to pool through locks. When the river began to rise, the wickets were dropped simultaneously by a tripping bar operated from the lockwall, which pushed the wickets' props to the side and allowed them to drop harmlessly to the foundation, again opening the channel for river traffic.

Merrill and Craighill thought the Chanoine wicket dams the solution to the problem of providing slackwater on the Ohio and Kanawha rivers, still retaining an open channel for navigation when coal fleets moved downriver at high water. Merrill, in 1875, recommended construction of a Chanoine movable dam and lock (No. 1) on the Ohio River at Davis Island, five miles below Pittsburgh. Others were to be built downriver if the first proved successful and coal shippers ended objections.

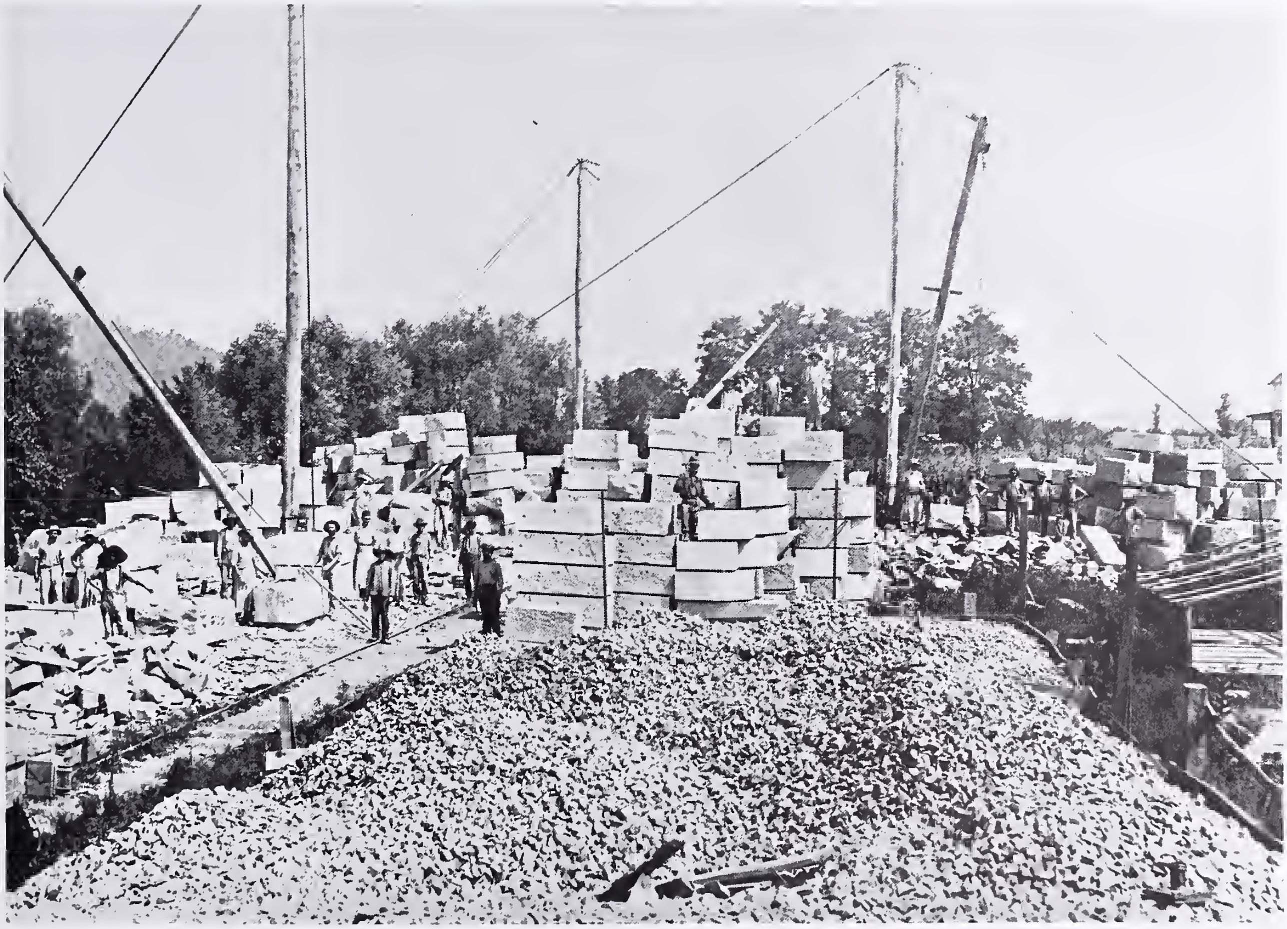
Canalization of the Kanawha Meets with Success

General Craighill in the same year (1875) recommended construction of twelve locks and dams on the Kanawha, numbered 1 to 12 from the Falls of the Kanawha to Point Pleasant on the Ohio. Craighill and Scott planned the three dams, Nos. 1 to 3, on the upper Kanawha as fixed structures, because fixed dams would be cheaper to build and the dams, located above the coal mines, would be used chiefly by stream packets, and canalboats if the Central Water Line were constructed. Dams Nos. 4 through 12 were to have movable Chanoine wickets to accommodate coal tows.

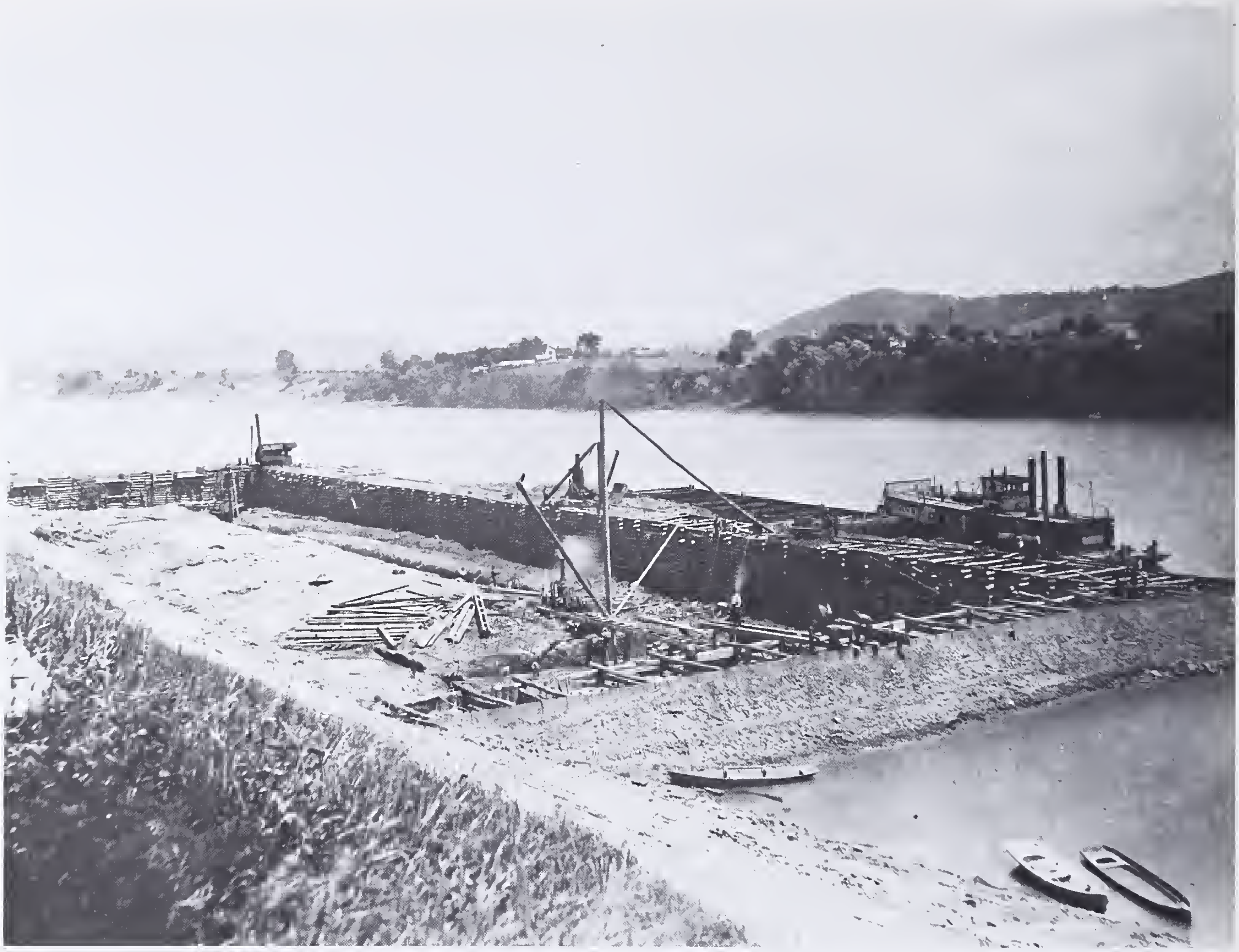
A board of engineers, led by Chief of Engineers Andrew A. Humphreys and accompanied by several members of Congress, inspected Colonel Merrill's plans for the Ohio, then traveled up the Kanawha on May 19, 1875, aboard the steamboat *Clara Scott*, to Charleston to examine the river and inspect General Craighill's plans for the Kanawha. At Charleston, a gala dinner was held for the board at the Hale House, with Dr. John P. Hale presiding. Hale spoke to the crowd, predicting that good times for the Kanawha valley were at hand, when slackwater navigation would "unlock the vast mineral treasures of our hills." General Humphreys afterwards began a round of toasts: Humphreys toasted the Corps of Engineers, Craighill toasted the Kanawha River, West Virginia Senator Henry G. Davis toasted the Windom Committee of the Senate (Ch. II), and so on into the early morning hours. "Thank God, we have found one river improvement that has merit in it!" said one Congressman, and this was the sentiment of all present. The survivors staggered to their rooms for a few hours sleep, and in the morning they boarded a train to return to Washington and report favorably to Congress. It was fortunate they took the train, for the captain of the *Clara Scott* sank her in seven feet of water on the trip downriver.

Congress approved the Kanawha River slackwater project and the construction of Davis Island Dam on the Ohio in 1875, and Craighill and Scott had the first two locks and dams on the Kanawha under construction by the end of the year. Lock and Dam 4 at Cabin Creek and 5 at Brownstown were chosen for early construction because they linked Charleston with the coal mines—there were no mines above the pool of Dam 4. Work on the project began on October 7, 1875, at Lock 5 near Brownstown and proceeded quietly, smoothly, and pleasantly until the contractor's workers went on strike in April. Construction at Lock 4 did not proceed as well. The contractor began work too late in the year and floods breached his cofferdam around the locksite before much was accomplished. When he resumed work in the spring of 1876 his dredge exploded its boiler.

The contractor for Dam 4 built his first coffer-



Stone yard at the site of Lock and Dam No. 7, Great Kanawha River.



View showing cofferdam and excavation for river wall at Locks and Dam No. 7.

dam at the site in the summer of 1877. On October 6 one of those sudden Kanawha floods breached the upstream side on the coffer. The contractor began repairs on October 29; on November 10 another flood washed out the lower side of the coffer, taking the contractor's pump with it. The cofferdam was repaired, and a new pump began removing water from the cofferdam, but on November 24 a third flood destroyed the cofferdam entirely. The sheriff seized the bankrupted contractor's property on December 12, and Addision Scott leased a dredge from Coal River Navigation Company, employed hired labor, and built a new cofferdam to continue the work.

Downriver at Dam 5 the contractor began work in early 1878, but in June his laborers struck for higher wages. The strike spread to Lock and Dam 4, and on June 23 a mob of strikers marched upriver to Paint Creek to force the foreman at Lock 3 to flee the country and the workmen there to join the strike. Addison Scott had to call out the United States Marshals to arrest the leaders and break up the mob. Work resumed, but the contractor at Dam 5 bankrupted and Scott had to complete Dam 5 with hired labor and government equipment.

Scott opened Lock and Dam 4 to navigation on July 3 and No. 5 on July 16, 1880. Operational problems immediately appeared. Chanoine wickets were supposed to be lowered nearly simultaneously by moving a tripping bar on the foundation of the dams, but the bars were constantly fouled by gravel, drift, and cinders, requiring much hard, disagreeable work to clear them for operation. Underwater divers had to be employed to clear and repair the tripping bars and other submerged movable parts of the dams. Raising or lowering the wickets was sometimes a very slow process, and this would never do on a rapidly fluctuating stream like the Kanawha.

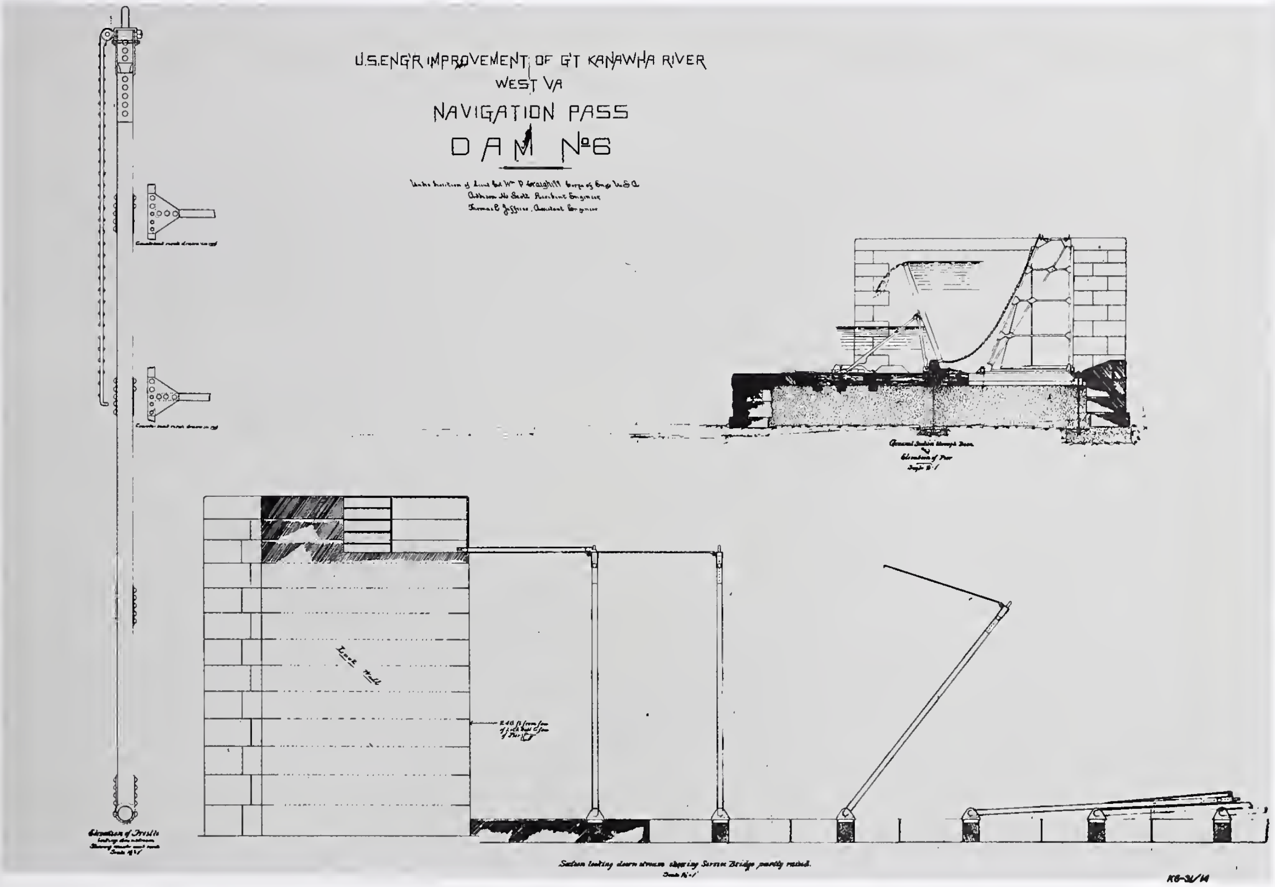
General Craighill and Scott learned of the Pasqueau *heurter* invented in 1878 by Alfred Pasqueau of the French Engineers. The *heurter*, anglicized in the United States to "hurter," was a metal slide placed in the foundation of dams under Chanoine wickets to eliminate tripping bars and the problems the bars caused. Craighill and Scott replaced the tripping bars in movable Dams 4 and 5 with Pasqueau hurters and the devices worked well. Scott modified and improved the Pasqueau hurters, developing the Scott hurter, which was used on the rest of the movable dams built on the Kanawha and Ohio rivers. Monsieur Pasqueau, however, who had accepted the Legion of Honor instead of royalties for use of his hurter in France, patented the invention in the United States and brought suit, asking compensation for use of the hurters on the Kanawha. After fourteen years of litigation, Pasqueau was awarded a substantial sum for use of his invention, but attorneys' fees had doubtless consumed the award.

By the time Locks and Dams 4 and 5 were opened to traffic in 1880, Craighill and Scott had revised project plans to eliminate two lock and dam structures, and to enlarge the size of the locks to be built below Charleston. Locks 4 and 5 were 274 feet long and 50 feet wide, but larger towboats and barges were being built, and to accommodate a towboat and three coal barges in a single lockage the locks from No. 6 downriver were built 313 feet long and 55 feet wide.

Dam 1, to be located above the Kanawha coalfield, was planned as part of the Central Water Line, and the Engineers determined not to build it until all the locks and dams below were completed. No. 1 was never built.

By coordinating the Kanawha River project with Colonel Merrill's plans for the Ohio River, arrangements were made to place Kanawha Lock and Dam 11 nearer the mouth of the river and to dispense with Lock and Dam 12. An Ohio River lock and dam would furnish slackwater on the lowermost section of the Kanawha up to Lock and Dam 11. Thus, by eliminating Nos. 1 and 12, the number of locks and dams built on the Kanawha was reduced to ten.

After Scott had construction of Locks and Dams 4 and 5 underway, he had contracted for the building of Nos. 2 and 3, the two fixed dams on the upper river, and for No. 6, the third movable dam. As these structures neared completion,


U.S.ENG'R IMPROVEMENT OF G'T KANAWHA RIVER
WEST VA
NAVIGATION PASS
DAM №6
General Section through Dam
Elevation of Pier
Section looking down stream showing Service Bridge partly raised.
K6-31/14

Drawing dated April 9, 1885, showing navigation pass for Locks No. 6.

Scott began building Nos. 7 and 8, followed by Nos. 9, 10, and 11, in downstream order.

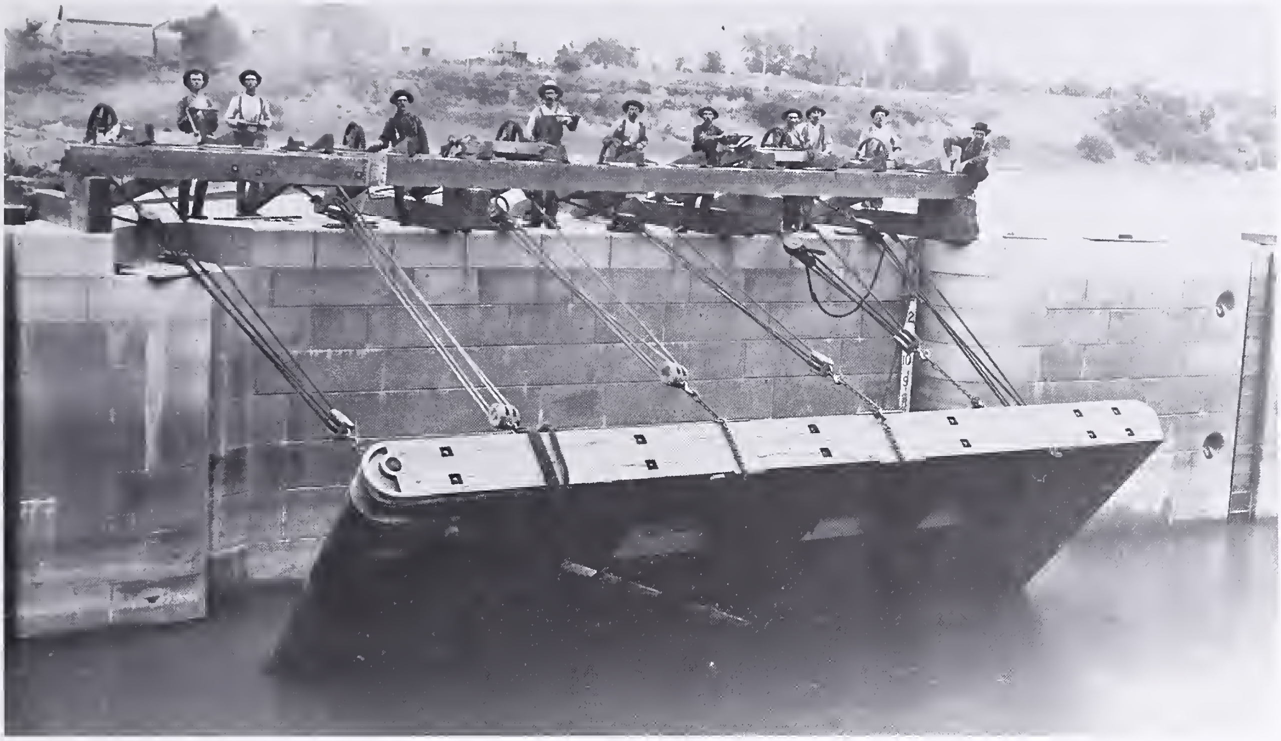
Construction methods became more or less standardized. Locks were built first. The contractor built a timber-crib cofferdam around the lockpit and filled the coffer with clay, which often was dredged from the lockpit. Water inside the cofferdam was pumped out and men went into the coffer, cleared the bottom to bedrock, placed the miter sills, and built massive stone-masonry lockwalls, using stone cut at nearby quarries, moved to the locksite by boat, and swung carefully into place by crane.

It was rough work and it took rugged men to perform it. Many of the stonemasons were immigrants from Italy and Ireland. The contractor's head stonemason at Lock 8, for example, was Patrick J. Fahey, an Irishman with previous experience on the Monongahela, Kentucky, and Cumberland rivers. John Sweeney, inspector for the Corps of Engineers at Lock 8, once noticed a stone slightly out of line in the lockwall and told Fahey to replace it. Fahey replied, "Wait a minute," and Sweeney said, "You will do it now or not at all!" Fahey's Irish temper flared, he responded with strong language, Sweeney gave him a "crack on the jaw," and a general melee—the "Lock 8 Massacre"—interrupted work for some time. So it often went down in the lockpit.

Contracts for dam construction were usually let after work on the lock was well along toward completion. Dams usually were built in three sections inside three cofferdams, built one at a time to avoid blocking streamflow and navigation entirely. Far below the swirling river, protected by a timber-crib cofferdam, men cleared the site to bedrock, laid a fifty-foot-wide stone masonry foundation for the dam, and installed iron bolts in the top of the foundation. Each bolt was precisely placed so the metal framework of the wickets and service bridges could be attached. Once the metalwork was completed, the wooden wicket boards were mounted on the frames (horses), the cofferdam removed, and the workers shifted to the next cofferdam.

This was dangerous work, but it was done before safety and accident-prevention programs were adopted in the construction industry and no record of accidents and lost time was maintained. The most serious problem in building the locks and dams apparently was sudden Kanawha River floods—one flood rose four feet in twenty minutes—which often overtopped and breached the low timber-crib cofferdams. Work was performed in summer and fall when the river was supposed to be warm and low, but floods were unpredictable. In 1896, for example, the Kanawha was so high that there were only four days in July and eight days in August when work inside the cofferdams could be accomplished.

Old Locks and Dam No. 4 on the Great Kanawha River with tow locking through.



Raising one of lock gates into place at Lock and Dam No. 11, July 16, 1898.

There was no typical Kanawha River lock and dam, for each structure varied in some respects from the other nine, but a description of Lock and Dam 6, completed near Charleston on October 11, 1886, will suffice.

Lock 6, built of fine cement-mortared masonry faced with smooth cut stone, rested on bedrock about 22 feet below the low-water mark. It was 410½ feet long on the outside and 342 feet long and 55 feet wide inside the chamber, with a lift of 8½ feet. Each whiteoak lock-gate leaf weighed 38 tons and turned on heavy steel pivots anchored in the masonry. Five valves, capable of emptying or filling the lock in four minutes, were built into the lock gates. The masonry foundation of the dam was 568½ feet long and 50 feet wide. The navigable pass through which river traffic passed at high water was closed with 62 Chanoine wickets, each 3 feet and 8 inches wide and 13 feet and 5½ inches long. The weir, which regulated the depth of the slackwater pool, was 310½ feet long, closed by 69 Chanoine wickets smaller than those in the navigable pass. A metal service bridge, on which men stood when moving the wickets, extended across the dam above the wickets; the bridge also could be collapsed on the dam foundation at high-water stages. At a total construction cost of $337,000, No. 6 formed a slackwater pool 14 miles long and six feet deep up to Dam 5; it was an excellent holding place for loaded coal barges and became one of the largest coal harbors in the world.

These bareboned facts do little to describe the sweat, the energy, the lifeblood devoted to building the Kanawha River locks and dams. Just as there was often friction among the workers inside the cofferdams, the administration of the project was frequently strained by clashing personalities and petty politics. Lieutenant Thomas Turtle, deputy to General Craighill, worked with Addison Scott at the Charleston office from 1876 to 1880. The West Virginia State Republican Committee complained to President Rutherford B. Hayes in 1880 that Lieutenant Turtle was employing Democrats and former Confederates, rather than Republicans and Union veterans, on the Kanawha project. Turtle responded that the charge was a "despicable lie" and asked for a hearing, but, over the protest of General Craighill, the Lieutenant was removed and transferred. Without knowing it, he had fired a relative of the President.

Lieutenant William M. Black replaced Turtle on the Kanawha, but did not remain long, for in 1881 Captain Ernest H. Ruffner, descendant of the pioneer Ruffner family of Charleston, took charge of the project. Captain Ruffner was a scholar and made a distinguished record in over forty years service with the Corps of Engineers, but he was something of a martinet, described by his colleagues as "exceedingly arbitrary." Ruffner once ordered a contractor to move earth in wheelbarrows, and when the contractor said the cost would break him Ruffner angrily replied in writing it would be a pleasure to break him. The contractor did the work as ordered, then brought suit, presenting Ruffner's letter as evidence, and won a large award.

Captain Ruffner and Lieutenant Black, a rising young officer who eventually became Chief of Engineers, immediately clashed and the Lieutenant arranged a transfer to the Davis Island project on the Ohio River. Acrimony also developed between Ruffner and Scott, and Scott tendered his resignation. Rivermen and coal shippers on the Kanawha flooded the War Department with requests for Scott's return, however, and the Secretary of War arranged it by transferring the Kanawha project back to General Craighill, who immediately rehired Scott. After this incident in 1881, Addison Scott had generally a free hand to build the Kanawha project, with only cursory supervision from General Craighill at Baltimore.

Scott built very well. He finished Lock and Dam 11, the last of the series of ten dams, on October 11, 1898, and reported the system had been completed after twenty-three years construction at a cost $100,000 below the original estimates made in 1875, a remarkable achievement then as now. Dams 4 and 5 had been the first movable wicket dams completed in the United States. The Kanawha became in 1898 the first river completely canalized with wicket dams, and it was one of the few nineteenth century slackwater projects which returned benefits far in excess of construction and operating costs.

According to a Charleston newspaper, the Kanawha slackwater project had been a "potent factor in the dethronement of hard hearted coal barons of other sister States who reigned supreme," had "gladdened the hearts of millions of people below its mouth who have been blessed by its cheap coal and cheaper transportation," and had been the "prime and potent factor in the development of Kanawha county and the Capital City." When construction began in 1875, the three coal mines in the Kanawha valley shipped 161,932 tons; by 1898 over seventy mines employing 9,000 men were in operation, shipping over a million tons by river at the lowest freight rates in the United States.

To aid burgeoning coal traffic, Scott began the practice in 1899 of lowering the Kanawha dams to form artificial navigation waves on the Ohio River. About four million bushels of Kanawha coal in 400 barges were waiting in the pool above Dam 11 in November, 1899, for a rise in the Ohio before proceeding to Cincinnati. Scott ordered wickets dropped at Dams 7, 8, 9, 10, and 11 in downstream order, drawing off water from each pool, spilling it then from No. 11 into the Ohio, and causing a two-foot rise in the Ohio to carry the coal fleet safely downriver to markets. The creation of artificial rises for navigation became a regular practice on the Kanawha and was also adopted on the Ohio River.

General Craighill, Chief of Engineers, at the completion of the Kanawha project, wrote: "Mr.

Coal fleets and boats near the mouth of the Kanawha River in early 1900's.

Scott has exhibited an unusual degree of skill as a designing and constructing engineer, in the management of the improvement, and in dealing with the many perplexing problems which have presented themselves for solution in its progress. To him is due more than to any other person the success of this work." But Addison M. Scott was, in effect, fired in 1901.

How Addison Scott Met His End

By 1901 all hope that the Kanawha River project would become part of the Central Water Line to Richmond on the Atlantic had faded. Since the Kanawha was a tributary of the Ohio, it seemed logical to group the Kanawha project with those on other Ohio River tributaries, and in 1901 the Kanawha was transferred from the Baltimore Engineer office to the office at Cincinnati. As it happened, Colonel Ernest M. Ruffner commanded the Cincinnati office in 1901 and the trouble with Scott in 1881 had not been forgotten. Scott determined to give service under Ruffner a trial, but found it a "great trial," and when Ruffner ordered Scott's transfer from the Charleston office, Scott said he would resign first. Ruffner discharged Scott for insubordination.

Governor A.B. White and Senator Stephen B. Elkins of West Virginia sent protests to the War Department; coal shippers and rivermen mailed protests; and the Charleston Chamber of Commerce told the Secretary of War that Scott's work on the Kanawha had been a major contribution both to the success of the project and in general to Kanawha valley economic development. But Colonel Ruffner was adamant and Scott left the Corps.

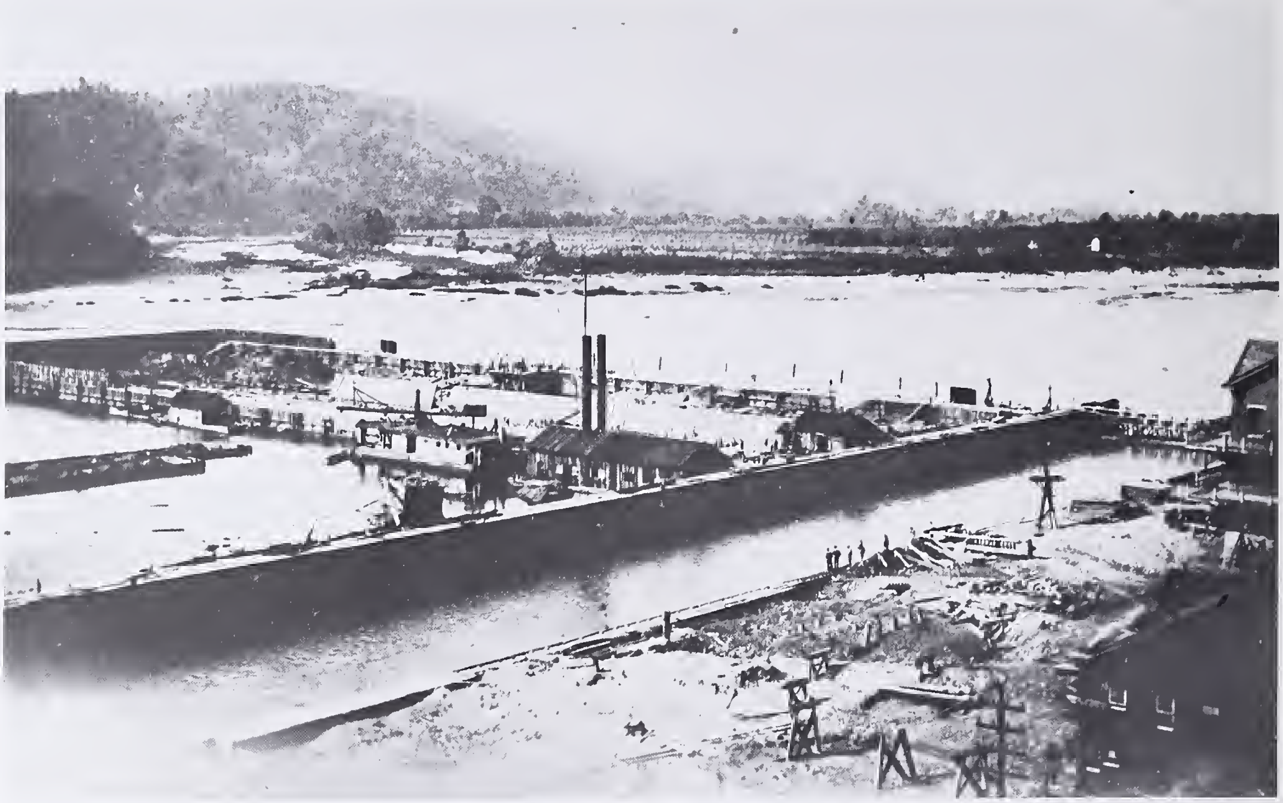
Perhaps when Dr. Hale wrote in 1901 of the smooth, frictionless progress of the Kanawha project the problems did seem trivial, the quarrels minor, but not to the men in the lockpits, the bankrupted contractors, or the project administrators. After retirement, Colonel Ruffner asked to be returned to active duty in 1917 to participate in the war against the "dread Hun," but his request was rejected—former Lieutenant William M. Black was Chief of Engineers.

Being fired was one of the best things that ever happened to Addison Scott. Still a youngster of sixty-one, he had saved and invested wisely, and had become one of the large landowners in Charleston. Scott married in 1907, and until his death in 1927 gaily traveled the world with his wife—Europe, Latin America, Australia, Hawaii, the South Pacific islands—but always he returned to Charleston and always he kept a daily record of precipitation and Kanawha River stages.

Davis Island Lock and Dam Was a Test Project on the Ohio

Between 1875 and 1901, Craighill, Scott, and their colleagues completed and placed into operation ten locks and dams on the Kanawha, but on the Ohio River Colonel Merrill ran into some serious opposition and difficult engineering prob-

Addison M. Scott at his home in Charleston, West Virginia.



—*Captain Frederick Way, Jr., Photo*

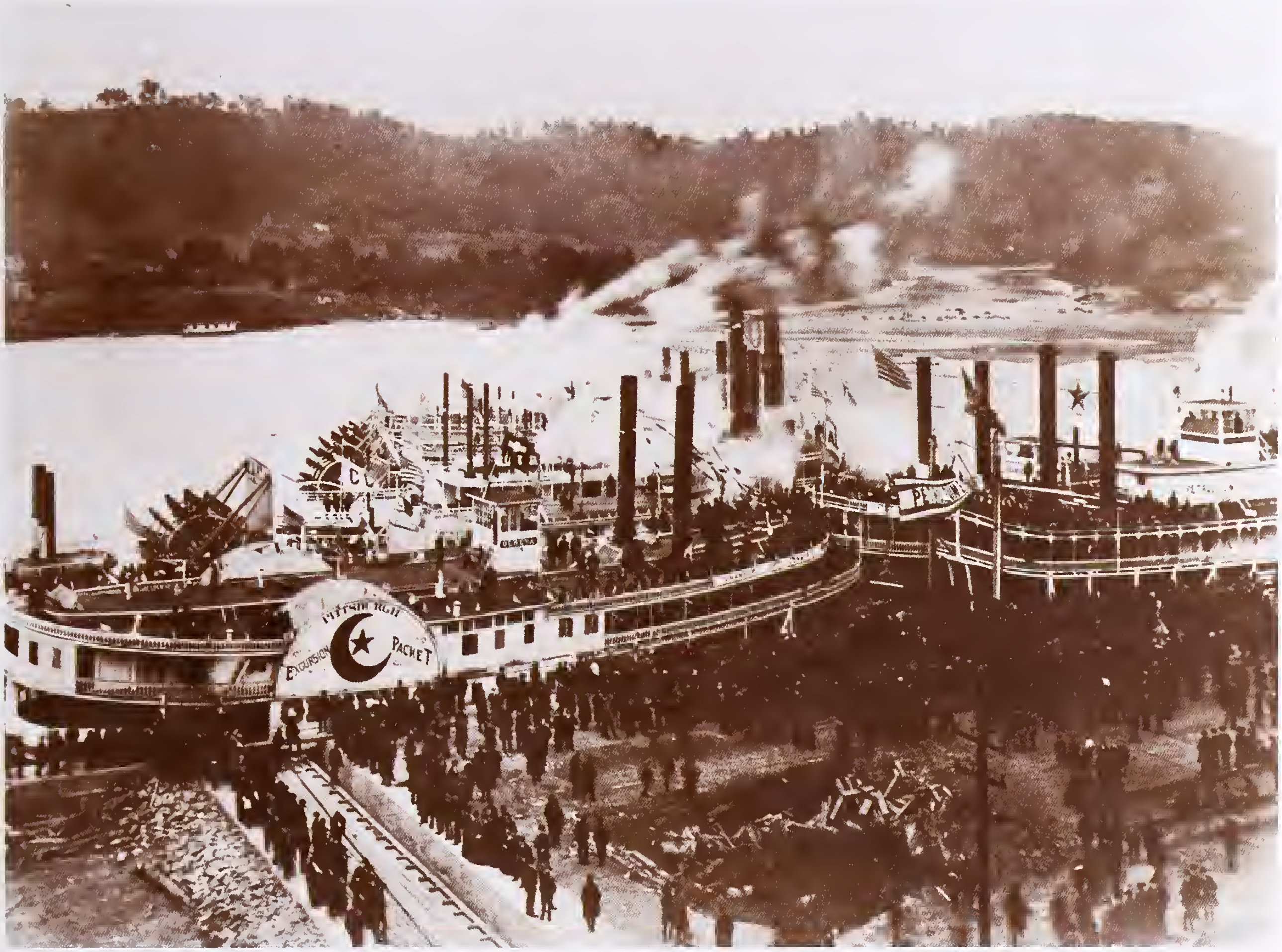
Construction of Davis Island Lock and Dam, Ohio River, 1884.

lems which so delayed construction that only a single lock and dam was completed on the river before the end of the century. Merrill allayed some of the fears of coal-tow operators by designing longer and wider locks than ever before built and by adopting movable Chanoine dams like those on the Kanawha, but influential opposition persisted and used every opportunity to thwart the project.

Before construction of the first lock and dam at Davis Island could begin, the state of Pennsylvania had to grant the United States jurisdiction over land it might acquire for the Ohio River project and cede the right of eminent domain. The first bill granting these rights passed both houses of the Pennsylvania legislature, but it was vetoed by the Governor because he questioned the wording of the bill. A revised bill passed the Pennsylvania house in the next session, but mysteriously disappeared in the Senate without action. Through influence of coal shippers, a third bill was defeated in the next legislative session. A fourth bill was presented in the following session, and with support from manufacturers who wanted the increased water supply slackwater might make available the bill was passed and signed by the Governor in 1877. Thus, Colonel Merrill was unable to begin construction of the first Ohio River lock and dam until late 1878, three years after construction had been started on the Kanawha.

The Davis Island Lock and Dam (No. 1) was similar to those built on the Kanawha, with a masonry lock and movable dam and weir of Chanoine wickets, but because of greater lock size and the width of the Ohio, the structure was much larger than those on the Kanawha. The most unusual feature of Davis Island Lock and Dam was the Merrill rolling lock gate. Lock gates on the Kanawha were the common wooden, swinging, mitering type; the 117-foot-long Merrill rolling gates at each end of the Davis Island lock were housed in a recess in the bank and rolled out on tracks to close the 110-foot wide locks.

"Padre" Merrill was assisted by a parade of outstanding engineers during the eight years the Davis Island project was under construction. At various times, he was aided by George W. Goethals, later of Panama Canal fame; William M. Black, Chief of Engineers during World War I; Frederick A. Mahan, an international waterways expert; Lansing H. Beach, who succeeded William Black as Chief of Engineers; and William



—*Captain Frederick Way, Jr., Photo*

Davis Island Lock and Dam dedication, 1885.

Martin, the civil engineer who stayed with the project from first to last.

Great care was taken in constructing the lock and dam at Davis Island, for the precedents set on French rivers and on the Kanawha were not fully applicable to a river as wide as the Ohio. And the structure had to be built and operated in such a way as to quash opposition from rivermen; otherwise, no more locks and dams would have been built on the Ohio and No. 1 would have been blasted out of the channel.

Davis Island was completed at a total cost of $910,000 in 1885, and on October 7 elaborate ceremonies were scheduled to open the project to navigation. Fireworks, cannon salutes, political orations, and a parade of gaily decorated steamboats were arranged to entertain a crowd of about 50,000 gathered along the riverbanks. As often happens on such occasions, the ceremonies were marred by accident: a cannon fired prematurely, blowing off a soldier's hands and injuring several spectators, and at the last moment the lower lock gates malfunctioned, preventing the steamboat pageant from locking through. Nevertheless, it was still a banner day, and when the political orations had ended, "Padre" Merrill stepped to the podium to declare the Davis Island celebration only the first of many until the ancient slur that the Ohio was dry all summer would fade into oblivion.

As his son raised the flag over the lock and the brilliant red, white, and blue billowed at the top of the staff, Merrill proclaimed: "In the name of the United States, I now declare the Davis Island Lock and Dam to be open to navigation. *Esto perpetua.*" It was the last such ceremony Merrill took part in, for the "Father of Ohio River Improvements" died in 1891 while inspecting one of the first projects for flood control completed in the Ohio basin. One of his West Point classmates commented that the symbol of Merrill's class at the military academy was the olive branch and the sword, the emblems of peace and war, and that "Padre" Merrill had distinguished himself in both fields.

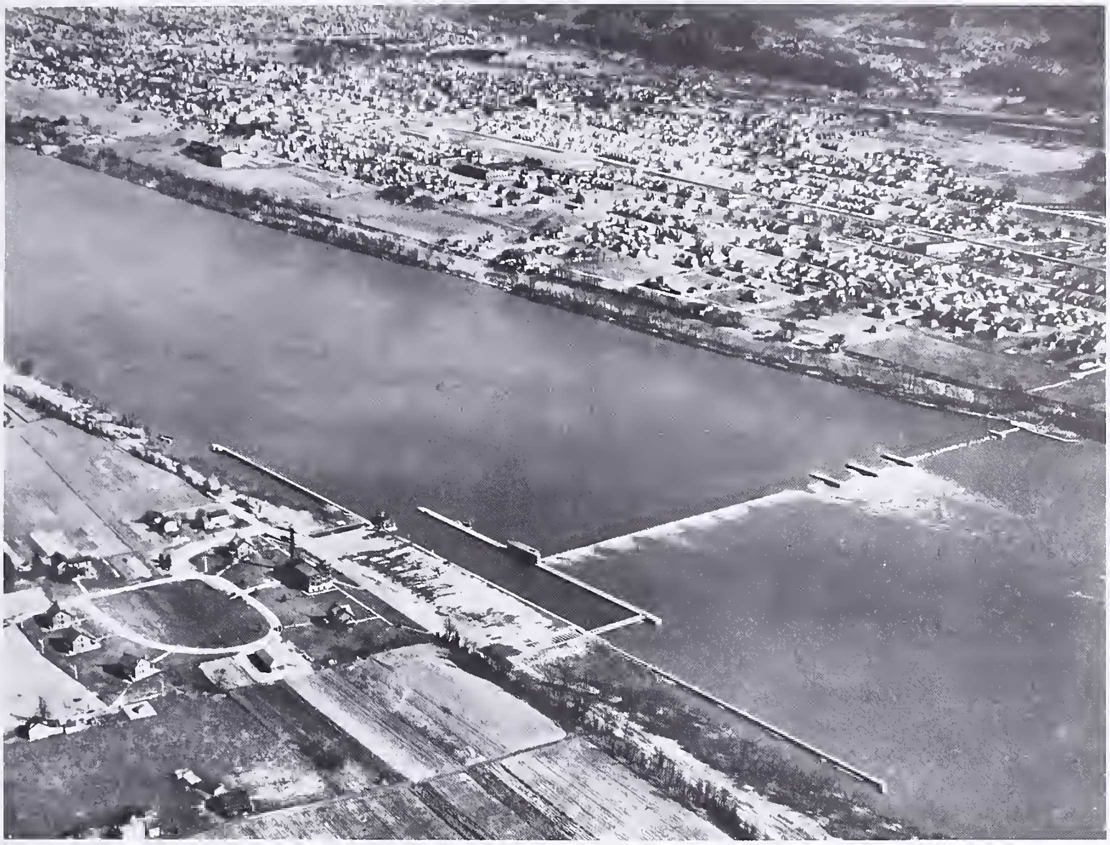
On October 9, 1885, newspapers reported with some amusement that the Davis Island lock gates had been repaired and, perhaps appropriately, a little market boat loaded with cabbages was the first to lock through, seizing the honor intended for the politicians. During its first year of operation, 14,015 boats and barges passed through the Davis Island navigable pass and 314 passed through the lock.

The Davis Island project became the experiment station for the Ohio River, where design was tested by actual operation, to improve the design of structures to be built downriver. Heavy scour, caused by water tumbling over the dam, was stopped by sinking barges loaded with stone below the dam, and it became the practice to build stone riprap "aprons" below each Ohio River dam. The first Merrill rolling lock gates were built of wood, and mounted on metal wheels and axles. On the basis of experience at Davis Island, later gates were built of metal. Plans had called for raising and lowering the Chanoine wickets in the weirs from service bridges, as was the practice on the Kanawha, but the service bridges at Davis Island were quickly destroyed by drift and runaway barges, and service bridges on the Ohio River canalization system were largely replaced by maneuverboats.

Problems with drift were so acute at Davis Island that a beartrap gate, like those invented by Josiah White on the Lehigh River in 1818, was installed in the dam in 1889 to pass drift. Beartrap gates, so called because they somewhat resembled "deadfalls" used by pioneers to trap animals, were two large wooden leaves mounted horizontally on the dam foundation with the upstream leaf overlapping the downstream leaf. By

—From the Steamboat Photo Collection of G. W. Sutphin

Landing at Cincinnati, Ohio, 1900, showing a number of steamers idle because of low water stage.



Old Lock and Dam No. 28, Ohio River.

opening valves on the upstream face of the dam, water was admitted under the two leaves and the resulting water pressure forced the two leaves up to form a dam; the leaves could be lowered simply by closing the valves. First installed at Davis Island dam merely to pass drift without lowering wickets, the beartraps were found very useful for passing minor rises and maintaining pool levels without lowering wickets, and they became a standard part of the dams later built on the Ohio. The first beartraps were also built of wood, but they were badly damaged when a stable caught fire upriver in 1891 and burning hay was thrown into the river; thereafter, beartrap gates were built chiefly of metal.

Sentiment Swings toward Canalization

Sentiment of rivermen began to swing in favor of extending the slackwater project down the Ohio after a hundred coal barges sank during an unexpected flood of July, 1888, but not a single barge in the harbor behind Davis Island dam was lost. Industry alongside the Davis Island pool was greatly benefited by a more reliable water supply, and the fears that the pool would be stagnant and a source of disease disappeared, for the reverse was true: sewage and other obnoxious effluents which formerly rotted along the shoreline during low-water seasons were submerged, diluted, and washed away. By 1890, both rivermen and industrialists, especially at downriver ports, were urging the building of more locks and dams like the Davis Island proejct.

Representatives of the Tristate area—the cities of Ironton, Ohio, Ashland and Catlettsburg, Ky. and Huntington and Guyandotte, W. Va.—won approval for a survey of the Ohio River between Ironton and Guyandotte in 1892. Lieutenant Harry Hodges of the Cincinnati Engineer office made the survey and found civic leaders of these "thriving manufacturing and shipping" communities wanted a lock and movable dam built below Ironton to establish a twenty-five mile slackwater pool for navigation and as a coal barge harbor on this much obstructed river section. The proposed lock and dam was not approved, however, for it was not certain in 1892 that the slackwater project on the

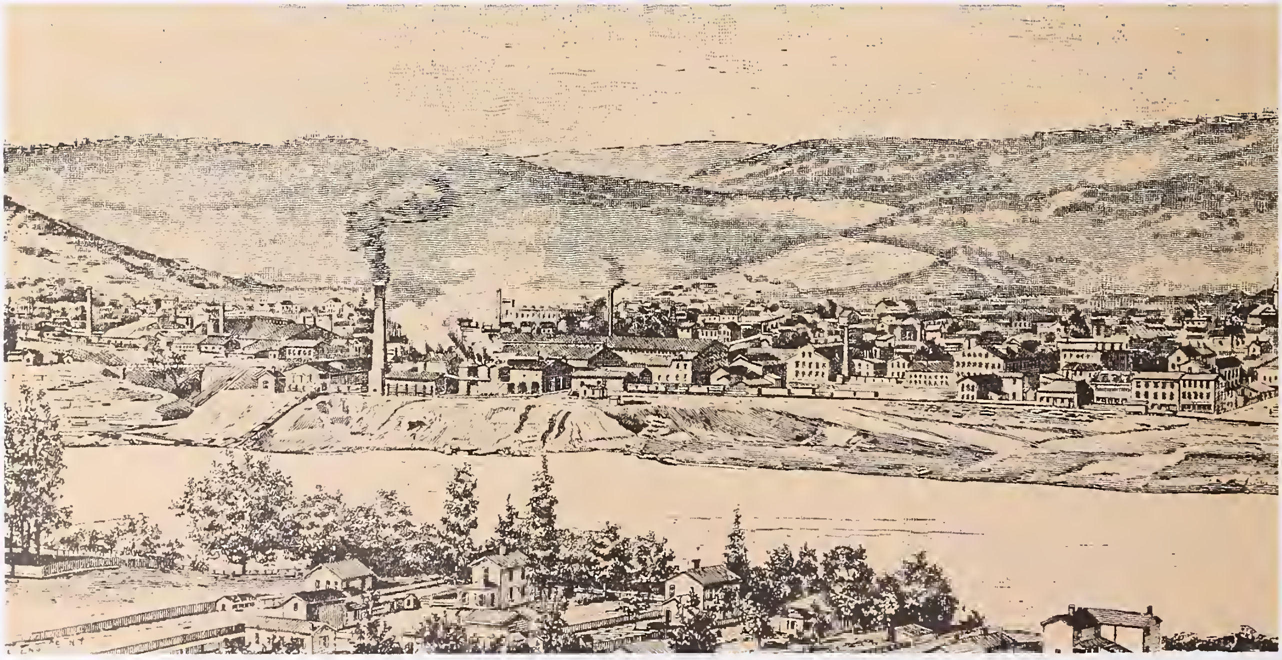
Ohio would be extended below Wheeling.

The high cost of locks and dams—about a million dollars for each structure on the upper river—caused Congress to be reluctant to authorize the extension of slackwater down the Ohio. Rivermen and shippers organized the Ohio Valley Improvement Association (OVIA) in 1895, with John L. Vance of Gallipolis as first president, to try to gain Congressional approval for more locks and dams. By sponsoring river trips for members of Congress, the OVIA dramatized the need of the Ohio River valley for improved waterways, and through publicity campaigns the organization pressed the urgency of the Ohio River slackwater improvement, contributing much to the end of the "neglect" of the Ohio by Congress.

Construction of five more locks and dams, numbered 2 to 6 to canalize the Ohio to the mouth of Beaver River near the Pennsylvania-West Virginia state line began in the late 1890's under the supervision of William Martin, former assistant to Colonel Merrill at Davis Island. Meager funding delayed construction, however, and the second lock and dam finished on the Ohio—No. 6, named Merrill Dam in honor of the Colonel—was not open to navigation until 1906.

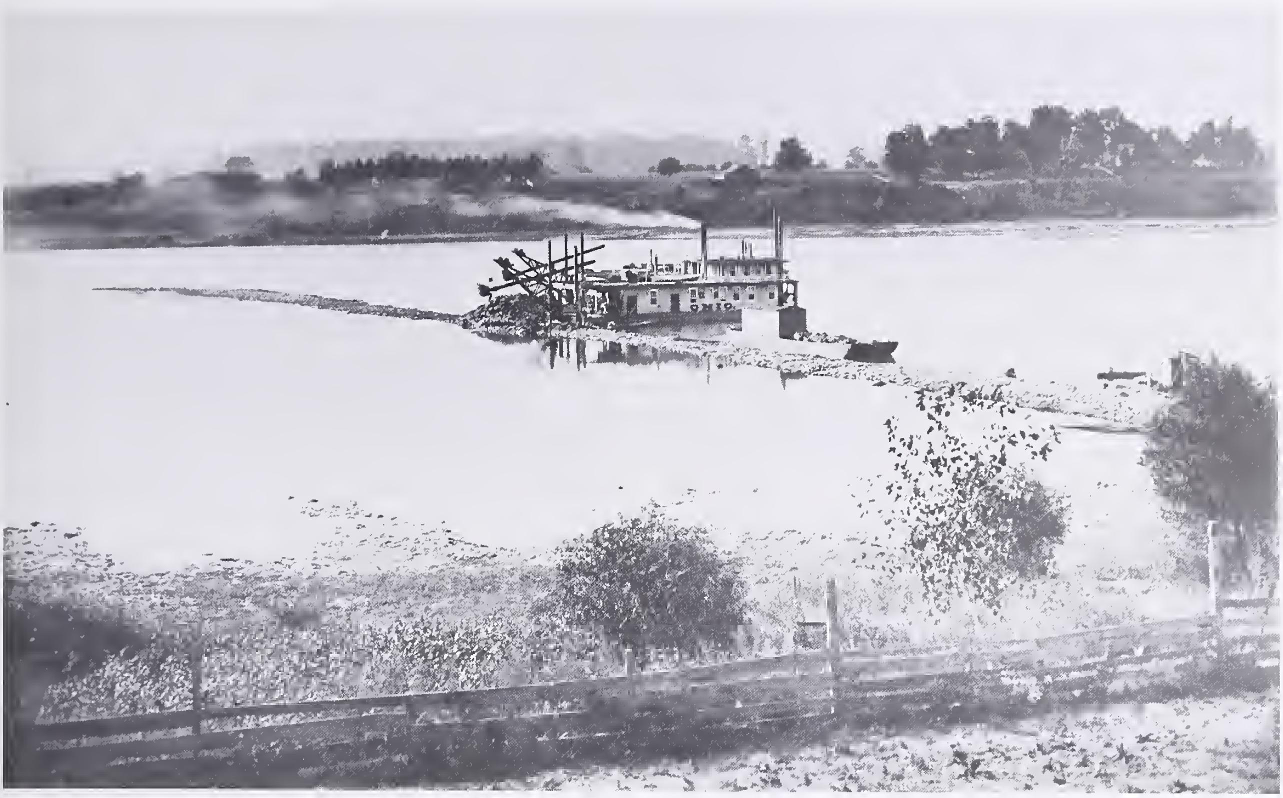
Army Engineers completed a survey of the Ohio from the mouth of Beaver River to Marietta in 1898 and recommended construction of twelve locks and dams (Nos. 7 to 18) to canalize the river to Marietta. The decision was also made to build the structures below major riverports and the mouths of large tributary streams first, rather than in downstream order. Dam 13 at Wheeling and No. 18 at Marietta were to be built first, followed by those in between. The survey continued from Marietta to Cincinnati in 1900, and in 1901 the building of twenty locks and dams (Nos. 19 to 38) below Marietta was recommended, with the dams below Parkersburg and the Little Kanawha River, Gallipolis and the Kanawha River, Ashland and the Big Sandy River, Portsmouth and the Scioto River, and Cincinnati and the Miami River to be given precedence.

By 1901, Lock and Dam 1 was completed, Nos. 2 to 6 were under construction, and thirty-two more were authorized to establish a six-foot depth for navigation downriver to Cincinnati. President Theodore Roosevelt, who detested pork barrel projects but was enthusiastic about waterways improvements, took office in 1901, and with his support some of the fat was skimmed from the pork barrel and redirected into the Ohio River project. Indeed, 1901 was a pivotal year for waterways: the National Rivers and Harbors Congress, a powerful waterways lobby, was organized in 1901; and the OVIA in convention at Parkersburg demanded that the Ohio River slackwater program be changed from a six- to a



—*Howe's Historical Collections of Ohio*

Ironton, Ohio, 1887, where previously there was strong support for a lock and dam but the project was not approved.



Dredges removing outer edges of Rising Sun Dike in September 1884.

nine-foot minimum depth!

A Decentralized Pattern of Organization Is Placed in Effect

The Army Engineer organization in the Ohio valley was also changed in 1901 to deal with the immense construction program beginning on the Ohio. Until 1888, Corps officers in charge of waterway projects reported directly to the Office of the Chief of Engineers (OCE) in Washington. In 1888, a rather informal Division organization was established, with senior Corps officers appointed to provide fatherly supervision over less experienced officers on various projects in a designated area. General Craighill, for example, became Southeastern Division Engineer in 1888 for an area south of the Mason-Dixon line and east of the Mississippi River; he continued to serve as District Engineer at Baltimore. The organization created in 1888 had little impact on Corps activities in the Ohio valley; it simply meant that on matters of import, the local, or District, Engineer officer channeled his reports to OCE through the Division Engineer.

In 1901, the decentralized Division/District organization became a formal administrative pattern, which was to endure. All work on the Ohio River had been performed since 1871 by the Engineer officer at Cincinnati—Colonel Merrill and his successors. In 1901 work on the Ohio was divided among Engineer Districts along the river and the Central Division was opened at Cincinnati to coordinate activities. Four Engineer Districts were established along the river, at Pittsburgh, Wheeling, Cincinnati, and Louisiville, each responsible for the stretch of river on which they were located.

Wheeling was selected as headquarters for an Engineer District because Charleston was too far from the Ohio and Huntington was still viewed as a small town, and because, said the Cincinnati Engineer officer: "West Virginia is a very rich state in its mineral resources and is developing quite rapidly at present; it has a frontage on the Ohio River from Georgetown to Huntington of 270 miles and includes the Little Kanawha Big Kanawha, and Guyandotte rivers, all under improvement."

Captain William E. Craighill, son of General Craighill, was appointed Wheeling District Engineer and officially took over the Ohio River work on November 16, 1901. Captain Craighill was first assigned charge of all locks and dams from No. 1 at Davis Island to No. 26 below Gallipolis, while the Cincinnati District was made responsible for Nos. 27 to 38, but Pennsylvanians angrily protested the transfer of Locks and Dams Nos. 1 to 7 to the Wheeling District. The Chief of Engineers explained to President Roosevelt that the Pittsburgh District had been responsible for the Allegheny and Monongahela river projects, but never the Ohio, which had always been supervised by Cincinnati. But the President yielded to political pressure and ordered the seven locks and dams on the Ohio River in Pennslvania transferred from the Wheeling to the Pittsburgh Engineer District. Captain William E. Craighill pointed out that if Engineer Districts were to be organized by state boundaries then the Upper Monongahela River properly belonged to the Wheeling District, but to no avail.

Could Canalization of the Ohio Be a Success?

Cynics were aghast at the chimerical idea of pumping funds into the Ohio River to canalize it from one end to the other. The project would become a disastrous "monument to the folly of man," critics said. And as more locks and dams were built on the Ohio at a cost of millions, in the face of a diminishing commerce seemingly on the way to extinction, the cries of the critics became a chorus of outrage. Captain F.W. Altstaetter of the Wheeling District thus vented his bitterness about the criticisms in 1909:

> The men who proposed and carried out the work so far done have been opposed at every point by contrary ideas. They have been accused of lack of knowledge, of lack of interest, of opposition to progress, of failure to appreciate the needs of the river—and . . . I have been cited myself as a horrible example of the petrified conservatism of the Corps of Engineers. From the beginning, the engineering features of the Ohio have been a source of discussion on the part of engineers and pseudo-engineers, projects and counter projects have been advocated and ignorance seems never to have discouraged anyone from launching a new theory of improvement.

The "petrified conservatives" of the Corps nevertheless continued to plod along with the Ohio navigation project as planned by Colonel Merrill in 1875. Congress gradually accelerated funding, and by the time the Huntington Engineer District replaced the Wheeling District in 1922 work on the Ohio River Canalization Project had reached a crescendo, larger at the time than any other construction project in the United States.

It had been commonly agreed among both critics and proponents that the Ohio River project would be the test. If it did not pay off in benefits far exceeding costs, then improvement of waterways for navigation in the United States should forever be abandoned!

—Captain Jesse P. Hughes, Photo

Towboats—"Catherine Davis," "Mary Steward," "M. B. Goble," "Sea Lion," "John C. Fisher," "J. O. Cole" and "Crown Hill"—near log raft fleets during high water at Catlettsburg, Kentucky.

Chapter VII

Tributaries and Pork Barrel Projects

The House of Representatives was in an uproar. The River and Harbor bill—the "pork barrel"—for 1878 was before the House, and Congressman Samuel S. Cox of New York had risen to the floor to proclaim: "Many of the creeks and rivers in this bill are not worth a dam!"

The final quarter of the nineteenth century was the golden age of the "pork barrel," when Congress distributed the national largess to insignificant streams across the land. In one River and Harbor bill of the era, Congress lavishly funded eighteen projects on which the Corps of Engineers had made *unfavorable* reports, and projects on sixteen streams which had never been examined by an officer of the Corps. Small indeed was the stream that was not improved for navigation in the waning years of the nineteenth century—and that was the point Congressman Cox was making in 1878.

After the laughter had subsided, Cox continued his critique of the 1878 "pork barrel" by observing that the bill included a large appropriation for the improvement of the Muskingum River in Ohio. Cox said he was born in Zanesville, and that he knew the Muskingum to be scarcely 150 miles long, from Coshocton to Marietta, and that it lay wholly within Ohio. Surely, he said, a stream that flows entirely within a single state is not worthy of the attention of Congress!

Cox recalled that Congressman David Cartter of Massillon, Ohio, had eloquently urged Congress to make appropriation for the Tuscarawas River, a Muskingum tributary, in 1852. Judge Cartter had asserted the Tuscarawas had been navigable since the deluge; that Indians had run their canoes up and down its bosom; that it was necessary as a tributary of the Muskingum; that the Muskingum poured its water into the beautiful Ohio; that the Ohio fell into the Mississippi; that the Father of Waters rolled to the everlasting ocean; and that therefore Congress should improve the Tuscarawas for navigation. The House of Representatives broke out in peals of laughter. "That is the nature of the argument that must be made here for most of these items," said Cox.

So it went each time a river and harbor bill was before Congress in the late nineteenth century. The editor of *Engineering News* said the River and Harbor Act of 1878 was a measure of comity; "you help me with my project and I will aid you with yours." Captain Frederick A. Mahan, assistant to Colonel William E. Merrill, declared the problem with the river and harbor bills was created by the fact that the press and public of each region regarded waterway projects in its neighborhood as vital, but denounced all other projects as robbery, as political jobs, as unnecessary to the commercial and economic development of the nation.

Congressman Cox would have described many streams improved by the Engineers for navigation in the central Ohio River basin as not "worth a dam." The Hocking, Elk, Gauley, New, and Guyandotte rivers were cleared of obstructions, and slackwater navigation projects were built or extended and repaired on the Little Kanawha, Big Sandy, and Muskingum rivers. Oddly, it was projects on little streams like the Guyandotte, the dregs of the pork barrel, which reaped the greatest benefits in comparison to cost.

An Uphill Fight on the Muskingum

The 1878 appropriation effort for the Muskingum castigated by Congressman Cox was part of an effort by the state of Ohio to cajole the United States into assuming responsibility for the rapidly decaying locks and dams built by the state before 1842, and managed since 1861 by a private corporation. The managers of the corporation apparently neglected maintenance of the structures, pocketed the tolls, and "got out from under" in 1877, leaving the project in a miserable condition. Rather than pump more state funds into the dilapidated project, the state hoped the United States would take over the "white elephant."

Congress made no appropriation for the Muskingum in 1878, but did approve a survey of the mouth of the stream as a possible ice harbor for Ohio River traffic. Thomas P. Roberts, son of Milnor Roberts, reported to Colonel Merrill that by constructing a new and larger lock at Dam 1 on the Muskingum at Marietta an excellent ice harbor could be created. With funds made available in 1879, Colonel Merrill planned a new lock at Dam 1 on the Marietta side of the Muskingum;

U.S. Engineer Office for Muskingum River dam repairs, Zanesville, Ohio, October 1887.

and, because it was located at a concave bend in the riverbank, he designed a unique "hourglass" lock, like no other ever built. The two lockwalls were close together in the middle, at the dam, and wide at the ends, to ease entry into the lock. Construction began in 1880, but meager and sometimes no appropriations caused construction to drag along for eleven years. Even after the lock was opened to navigation in 1891, it was not much used until 1896, when a drawspan was completed in the Baltimore and Ohio Railroad bridge below the lock.

Congress yielded to pressures from Ohio in 1884 and approved a survey of the Muskingum to determine what might be required to repair the slackwater project. An employee of the Ohio Board of Public Works said repairs to the structures might cost as much as $114,000. Colonel Merrill said that, from long and hard experience, he knew that "nothing is more uncertain than estimates on hydraulic works," and he raised the repair estimate to $200,000. Congress provided funds for repair of the Muskingum system in 1886, and after legal matters had been settled the government took over the Muskingum from Ohio on April 7, 1887. Ohio also delivered all of its maintenance equipment on the Muskingum—three skiffs, six axes, and two shovels.

On inspection of the structures in 1887, Colonel Merrill found that Ohio had spent nothing to maintain the locks and dams for several years, and that Dam 2 at Devol and Dam 5 at Luke Chute had been breached, bringing through-navigation to a complete halt. He concluded that not a single dam was safe, that the project must never have been in charge of a professional engineer, and that funds for maintenance had been largely wasted through "sheer ignorance." Merrill arranged the quick repair of Dams 2 and 5, but new breaks occurred in an 1887 flood. The estimated cost of repairing the Muskingum slackwater project was revised sharply upward.

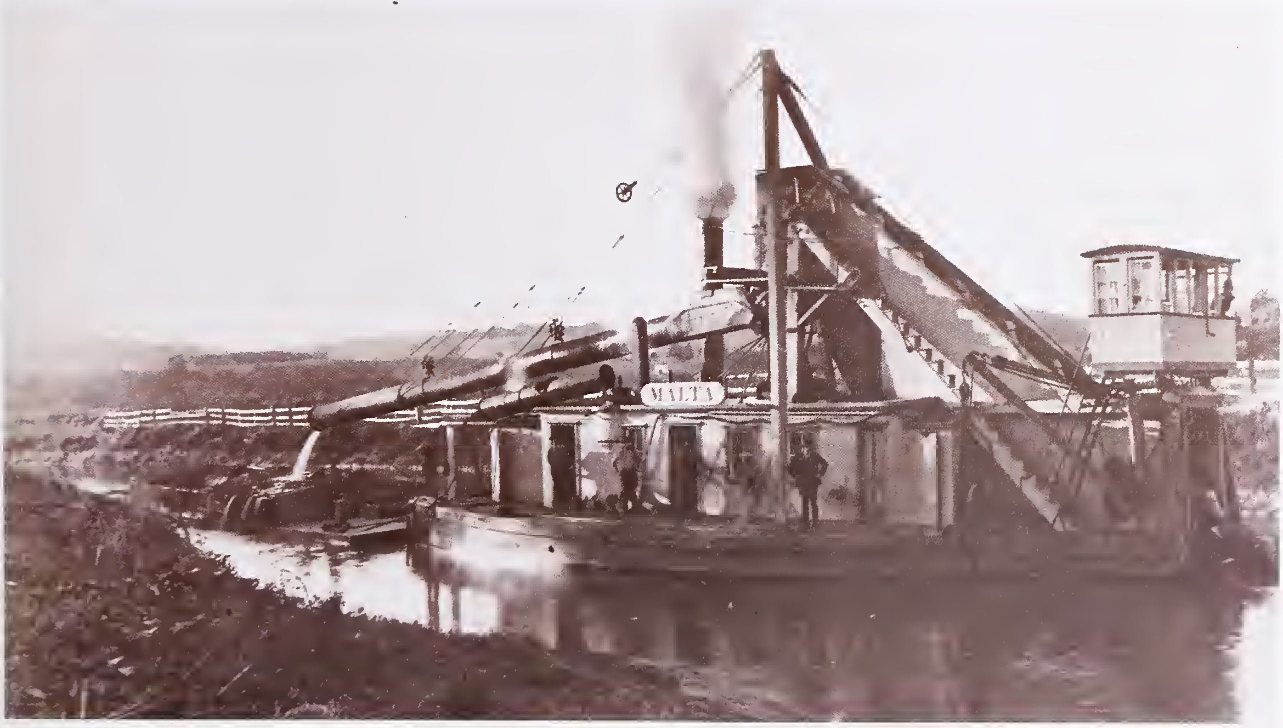
Merrill placed Lieutenant Lansing H. Beach in charge of hasty emergency repairs on the Muskingum.Brush and stone were thrown onto the upstream faces of the dams to hold them until they could be rebuilt, lockwalls were shored up and lock gates repaired, and the old lateral canals were dredged out by men wielding shovels and hoes and by sternwheel steamboats backing, or "crabbing," up the canals to stir up the mud. During the rush to save the project, several men lost their lives in accidents, and several unfortunate incidents occurred. To save old Lock 7 at McConnelsville, for example, the old millrace behind the landward wall was filled in midwinter. The men drilled holes in the hard-frozen ground, blasted out fill materials, and carted chunks of the icy mass to the millrace and dumped it in to thaw later. The fill had scarcely settled when emergency repairs to the lockwalls became necessary, and the workers had to return to the fill and shovel it back out of the millrace. This was a source of considerable humor to onlookers, but not to the men on the business end of the shovels.

The ladder dredge *Malta* went to work on the canals and lock approaches in 1889, the dams and locks were repaired or rebuilt as fast as they failed, and the channels were cleared of accumulated snags in what Colonel Merrill described as a "persevering and masterly contest against heavy odds." In 1892 the Engineers were able, for the first time, to keep the Muskingum open to navigation an entire year, and 8,058 boats, carrying 55,536 passengers and shipments of coal, livestock, oil, wheat, corn, wool, lumber, brick, hay, salt, and potatoes, passed through the locks. Eight steamers were running regularly and fourteen intermittently on the river by 1900, but the United States had paid dearly for this traffic.

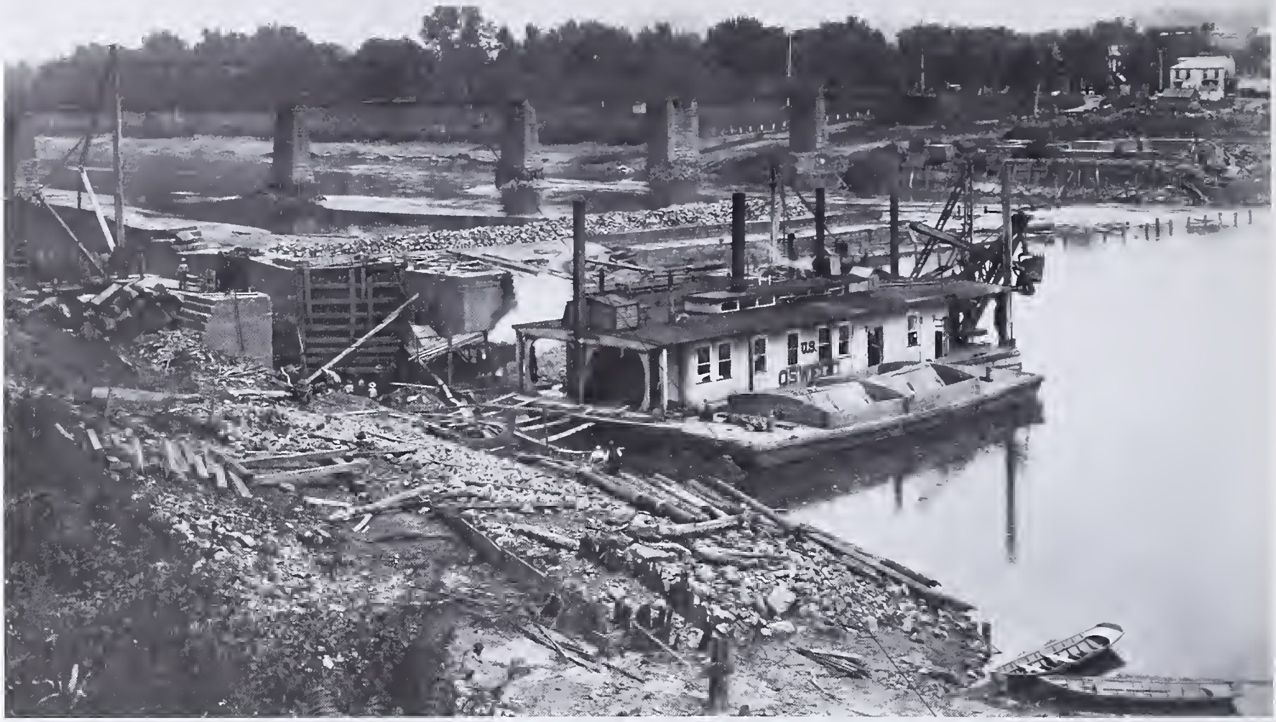
There had been hope in the Muskingum valley when the United States took over the project that Lock and Dam 11 between Zanesville and Dresden would be rebuilt to permit shipment of coal from mines along the upper river up the Muskingum and to the Great Lakes via the Ohio and Erie Canal from Dresden and Coshocton to Cleveland, but Congress had not approved. In 1902, however, Congress authorized study of canalizing the river from Zanesville to Coshocton, and Colonel Ernest H. Ruffner found seventy-five boats were navigating the Ohio and Erie Canal. Why not build a new Lock and Dam 11 between Zanesville and Dresden, Ruffner asked, to determine whether commerce between the Muskingum and Cleveland would develop. If it did, then two more locks and dams could be built to extend slackwater on the Muskingum to Coshocton.

Congress in 1905 approved construction of new Lock and Dam 11, provided Ohio spent at least $200,000 to repair the Ohio and Erie Canal from Dresden to Cleveland. Ohio complied, expending nearly $800,000 on the canal before 1909.

Edmund Moeser, the assistant engineer who had immediate charge of the Muskingum project for many years, directed construction of Lock and Dam 11, a concrete structure with movable Boulé gates on the dam crest two and a half miles below the site of the old Symmes Creek Lock and Dam.



U.S. Dredge "Malta" operating in Lowell Canal, Lock No. 3, Muskingum River on October 16, 1889.



Dipper Dredge "Oswego" moored at the original Lock and Dam No. 1, Muskingum River. View shows the old lock and dam with the second lock No. 1 being constructed on the opposite shore on August 7, 1890.

No. 11 was completed in 1910, but little traffic developed; only 370 tons of commodities and 1,727 passengers locked through No. 11 in 1912. The money spent by the Untied States on No. 11 was wasted, and the funds Ohio put into repair of the canal were lost when the record flood of 1913 wrecked the canal.

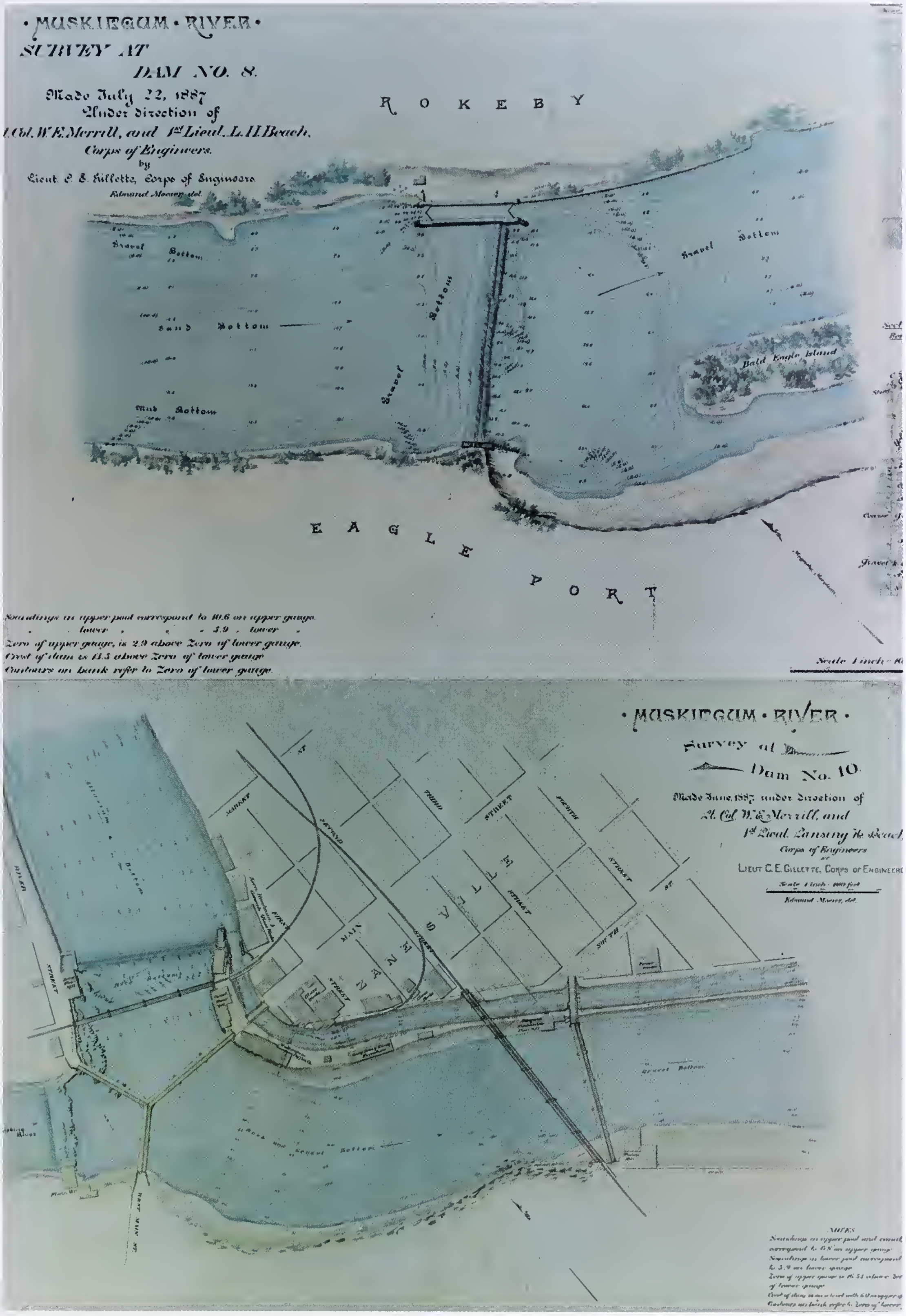
The 1913 flood destroyed every bridge over the Muskingum below Zanesville, filled the bypass canals and lock approaches with debris and mud, damaged the locks and dams, and caused landslides into the navigation pools. The Engineers restored navigation on the Muskingum after 1913, but the river commerce never entirely recovered. In late 1913 a Muskingum valley farmer urged that the navigation structures be blasted out of the river. The dams increased flood heights, he said, and the project is a "white elephant on Uncle Sam's hands," costing the government about $800 a day to serve a single steamboat. The District Engineer told the Chief of Engineers in a confidential report that the farmer was "not so far wrong as to essentials as might be supposed." But the Muskingum project was operated at the least cost possible for fifty years after 1913, before the United States paid Ohio to take it back.

Vicissitudes of the Little Kanawha

The history of the Little Kanawha navigation project was not much different from that of the Muskingum. The Little Kanawha, rising in Upshur County, W. Va., follows a tortuous 167-mile course generally northwestward through Braxton, Gilmer, Calhoun, Wirt, and Wood counties to its juncture with the Ohio River at Parkersburg. Pioneers navigated the stream at an early date, flatboats carrying the product of saltworks near Bulltown in Braxton County floated out of the river, and the *Paul Pry* was the first steamboat to ascend the stream, in 1836, to the "wonder and terror" of the mountain folk. The *Scioto Belle* was the first steamer to reach Elizabeth in Wirt County in 1842, and in 1844 the *Lodi* began a regular run from Parkersburg to Elizabeth.

Citizens of Parkersburg, Elizabeth, and Glenville organized the Little Kanawha Navigation Company in 1847 to improve navigation from Parkersburg to Braxton County, but accomplished little until the Little Kanawha oil boom began in 1860.

The Rathbone Oil Company was the first to drill deliberately for oil in West Virginia, and it brought in some highly productive wells at Burn-


• MUSKINGUM • RIVER •
SURVEY AT
DAM NO. 8.
Made July 22, 1887
Under direction of
Lt. Col. W. E. Merrill, and 1st Lieut. L. H. Beach,
Corps of Engineers.
by
Lieut. C. E. Gillette, Corps of Engineers.
Edmund Moeser, del.
ROKEBY
EAGLE PORT
Gravel Bottom
Sand Bottom
Mud Bottom
Gravel Bottom
Bald Eagle Island
Soundings in upper pool correspond to 10.6 on upper gauge.
" " lower " " " 3.9 " lower "
Zero of upper gauge, is 2.9 above Zero of lower gauge.
Crest of dam is 13.5 above Zero of lower gauge
Contours on bank refer to Zero of lower gauge.
Scale 1 inch = 40
• MUSKINGUM • RIVER •
Survey at
Dam No. 10
Made June, 1887 under direction of
Lt. Col. W. E. Merrill, and
1st Lieut. Lansing H. Beach,
Corps of Engineers
by
LIEUT C. E. GILLETTE, CORPS OF ENGINEERS
Scale 1 inch = 100 feet
Edmund Moeser, del.
ZANESVILLE
MARKET
SECOND
THIRD STREET
FOURTH STREET
FIRST
MAIN STREET
SIXTH
NOTES

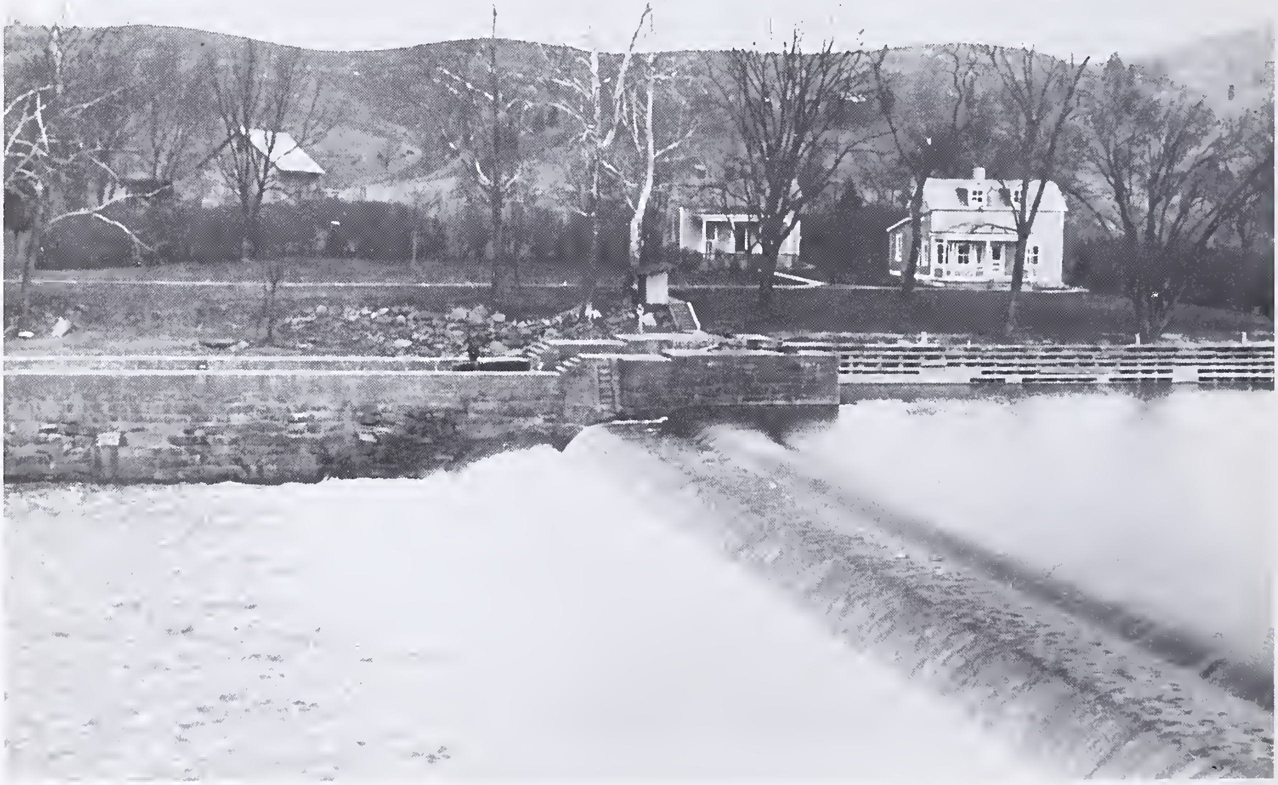
Typical of the maps made for all dams on the Muskingum River resulting from a survey made by Colonel Merrill and Lt. Beach in 1887.

ing Springs—"Oiltown"—in 1860. Drilling equipment was brought in on flatboats up the Little Kanawha. In 1861 the Burning Springs wells produced four million gallons of oil. Oilmen reorganized the Little Kanawha Navigation Company in 1860 to improve the river for boats moving the oil to markets, but the company had done little before Confederate cavalry commanded by General William E. Jones galloped into the oilfield in 1863 and made Burning Springs the "most important industrial complex" destroyed by the Confederacy during the war. The gray-clad troopers burned 300,000 barrels of petroleum in boats and barges on the Little Kanawha at Burning Springs. Subsequently, petroleum was shipped down the Little Kanawha until 1896.

The Little Kanawha Navigation Company, with financial support from Wirt and Wood counties and the Parkersburg municipal government, reorganized under a West Virginia charter in 1867 and began construction of four locks and dams to provide four-foot slackwater up to Burning Springs. The dams were the common rockfilled, timber-crib variety, with stone-masonry locks that allowed boats no longer than 125 feet nor wider than 22 feet to pass. The project was completed in 1874 at a cost of about $240,000.

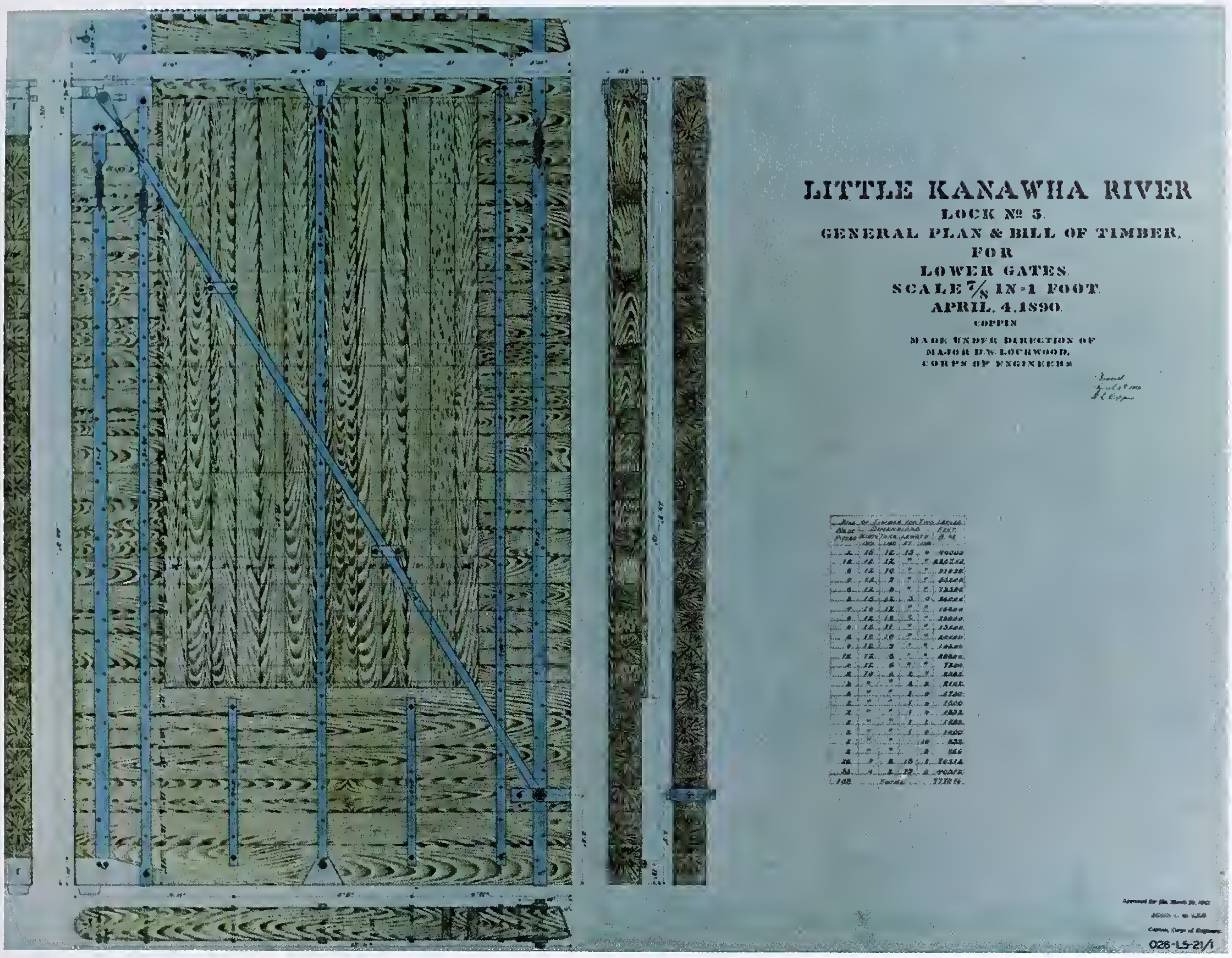
By 1874 petroleum traffic on the Little Kanawha was diminishing, but millions of board feet of lumber and forest products were floating down the river, much of it destined for European markets.

Assistant Engineer E. J. Carpenter examined the Little Kanawha for Colonel Merrill in 1875 and reported that slackwater navigation might be extended upriver to Bulltown by construction of twelve locks and dams above the four privately owned structures. In submitting the report to Congress, Colonel Merrill estimated a slackwater project to Bulltown might cost $758,400 and suggested that if that cost were considered excessive, clearing the stream of rocks and snags might be considered at about a tenth the cost of the slackwater project.



—Steamboat Collection of G. W. Sutphin

Lock and Dam No. 4 on the Little Kanawha River, located at Palestine, West Virginia.



Plans for lower gates at Lock No. 5, Little Kanawha River, completed in 1891.

Congress funded the open-channel project in 1876 and Colonel Merrill put gangs to work clearing the channel from Braxton County to the head of slackwater, plowing and scraping channels, blasting away boulders, cutting snags, building wing dams, and installing hydraulic, beartrap-type chutes for navigation through milldams at Glenville, Spicer's Mill, and Cutlips, the latter 124 miles above Parkersburg.

Colonel Merrill requested an appropriation in 1877 to build a single lock and dam (No. 5) above the four company-owned structures to extend slackwater navigation forty-eight miles above Parkersburg. Congress authorized the project in 1880, and Colonel Merrill designed a timber-crib dam and stone-masonry lock with a 150-foot-long by 28-foot-wide lock chamber. Construction was delayed, however, because Congress was not eager to build a lock and dam on a stream subject to tolls set by a private company. Nevertheless, No. 5 was completed in 1891 and steamboats began to run regularly to Creston near the head of slackwater.

Clearing the channel above slackwater continued. In early 1897, on the crest of a flood, the steamboat *W.A. Hilton* became the first to reach Glenville, 106 miles upriver, where it was welcomed by the entire population of the village. Steamboat traffic on the upper section of the Little Kanawha did not become common, however, and freight was handled chiefly by light-draft gasboats, forerunners of the modern diesel boats, powered by single-cylinder gasoline engines. Even Grantsville on the Little Kanawha in Calhoun County became a boatbuilding location, when several gasboats were built there to ply between Creston and Glenville. Among the gasboats chugging up and down the Little Kanawha in 1900 were the *Yukon*, *Clipper*, *Calhoun*, *A.C. Barney*, *Mabel B.*, *Edith H.*, and the thirteen-ton *Creston*, which was the largest of the fleet.

The gasboat and log-rafting commerce on the upper Little Kanawha was much benefited by open-channel navigation improvements, but navigation on the lower slackwater pools was irregular.

Benjamin F. Thomas, assistant engineer in charge of Lock and Dam 5, reported in 1890 that the four locks and dams owned by the navigation company were "old, leaky, and dangerous when they are in condition to use at all, and much of the time navigation is suspended entirely, owing to breaks or the withdrawal of the pools to make repairs." Substantial public support for extending slackwater up to Glenville to permit the shipment of coal from the upper basin developed during the 1890's, but the Army Engineers reported in 1895 that seven locks and dams would be required above No. 5 and that the four privately owned locks and dams would have to be repaired and enlarged to handle a coal barging traffic. The Little Kanawha Navigation Company was asking $250,000 for its property, and the Engineers believed this too high for structures which would have to be rebuilt from the riverbed up.

By 1903 the company locks and dams were near collapse and people of the Little Kanawha valley were anxious for the United States to purchase the structures, repair them, and free the river from tolls. The Board of Engineers for Rivers and Harbors conducted a public meeting at Parkersburg on September 25, 1903, where the city of Parkersburg and Wirt and Wood counties (which owned much stock in the navigation company and had collected dividends larger than their original investment over the years) agreed to donate their stock without cost to the United States. The Board of Engineers recommended purchasing the navigation company property for $75,000 and repairing the old locks and dams, but did not approve of enlarging the old locks or extending slackwater upstream to the coal mines.

Congress approved the purchase in 1905, and the Corps of Engineers took over Locks and Dams 1 to 4 on November 1 and began repairs. Five steamboats and eighteen gasboats carrying 7,000 passengers and about 75,000 tons of com-

—Steamboat Collection of G. W. Sutphin

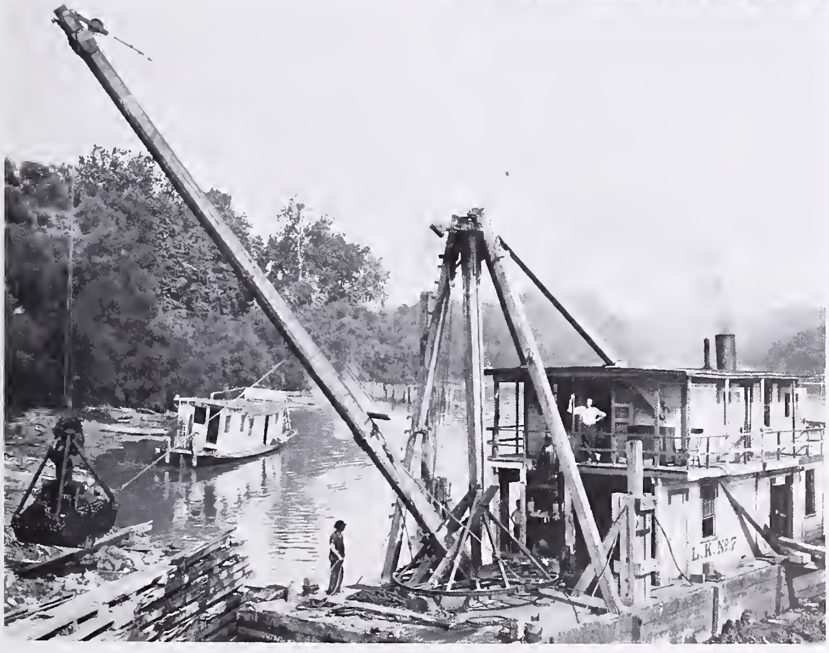
Towboats on the Little Kanawha River above slackwater at Big Root Shoals, eight miles below Grantsville, Virginia.

modities passed through the Little Kanawha locks in 1905, but in the same year the Little Kanawha Railroad was under construction across the basin toward Burnsville. It was apparent the railroad would take much traffic from the river, but public demand for the extension of slackwater up to the coalfield in Gilmer and Braxton counties persisted. Senator Stephen B. Elkins of West Virginia said in 1910: "The improvement of the Little Kanawha River would have the effect of creating an enormous traffic, besides keeping down the rates on the railroads which is most desirable. I believe the traffic which would be moved on the Little Kanawha River, if improved, would exceed that of any other river in the States."

Major Frederick W. Alstaetter, Wheeling District Engineer, prepared plans in 1910 for building fifteen locks and dams to handle coal barges from Burnsville to Parkersburg. He also prepared an alternate plan, using the Ellet reservoir system for maintaining navigable stages by building dams and reservoirs on Steer Creek, on Sand Fork, and at Burnsville on the main stem of the Little Kanawha. Estimated construction costs of either plan were thought far too high to be justified as a benefit to navigation, and nothing was ever done to extend slackwater up the river.

The funds spent to repair and maintain the locks and dams provided but few benefits in comparison with cost, for railroads and improved highways cut deeply into river commerce, ending traffic above Lock 5 about 1923. Doubtless the decision not to extend the slackwater project upriver toward the coalfields was wise, for an effort to accomplish a similar end by building locks and dams on the Big Sandy River and its tributaries during the same era was little short of disastrous.

Repairs being made to Lock and Dam No. 5, Little Kanawha River in 1911.



Dredge "Little Kanawha No. 7" and gas towboat "Glenville."

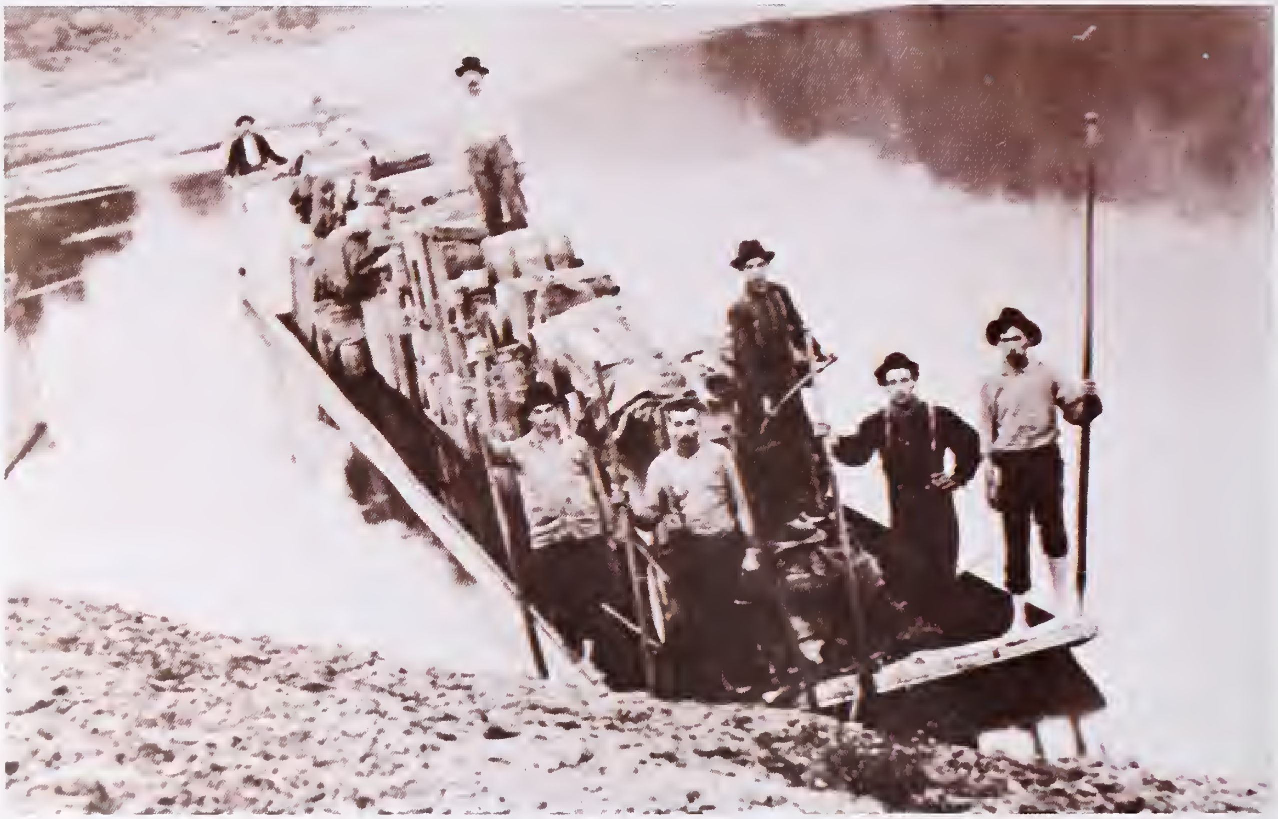
Problems of Big Sandy Navigation

The Big Sandy slackwater project was primarily an effort to emulate the success of the Kanawha River slackwater project in moving immense coal tonnages to markets and generating related economic activities. Coal had been shipped down the Big Sandy in flatboats from the Peach Orchard mines and mines at Industry (Boldman) near Pikeville, Ky. on every "coal tide" for many years before the Civil War. There being no railroads or good roads in the region, the Big Sandy River and its two forks—Levisa Fork, flowing from Virginia across eastern Kentucky, and Tug Fork, bordering West Virginia—were the effective highways into and out of the mountain citadels of the upper Big Sandy basin. Farm produce in flatboats and timber rafts swept down the forks and main stem of the Big Sandy on the crests of floods, and supplies were brought in by pushboats—small bateaux carrying five to twenty tons that were poled upriver keelboat-fashion.

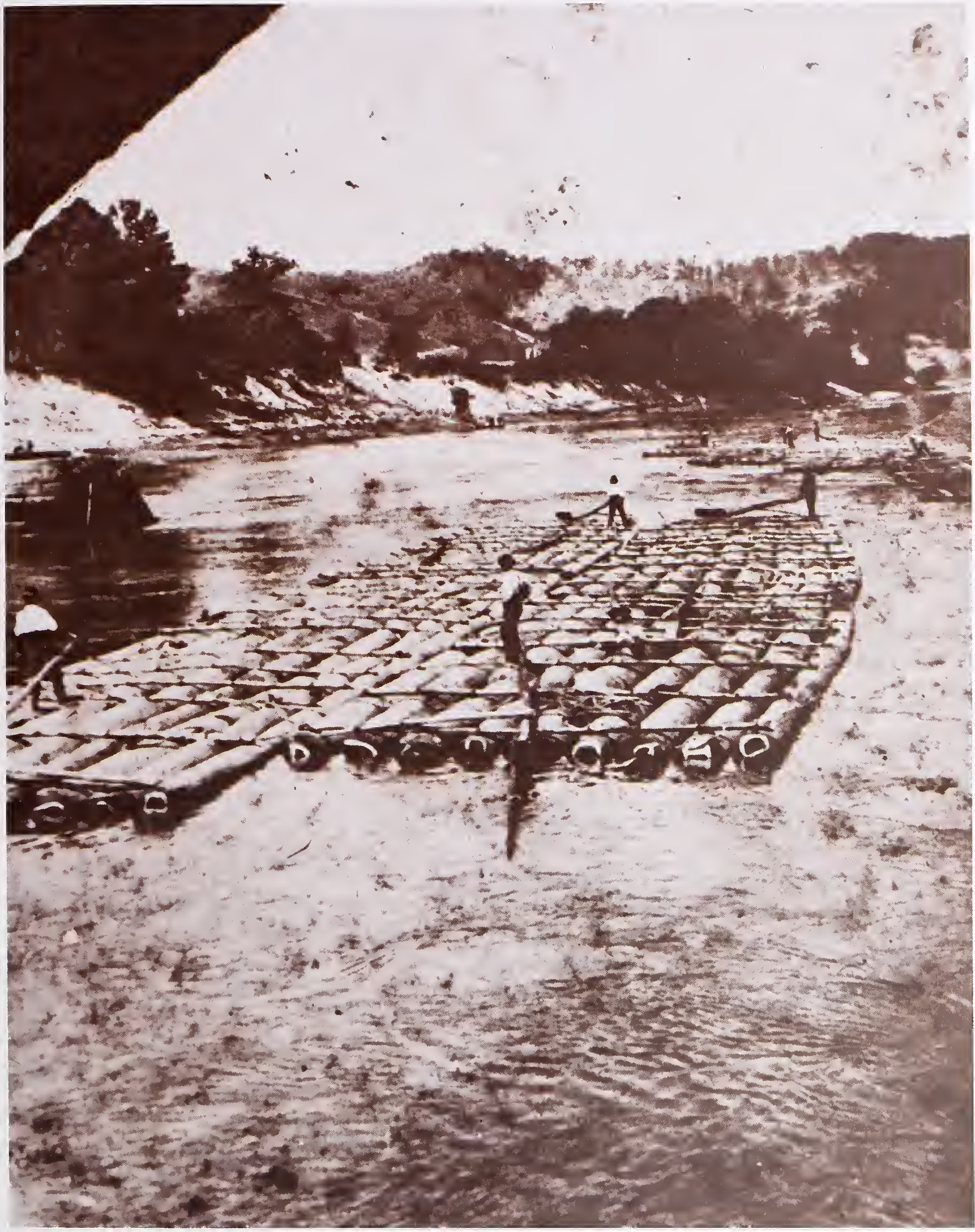
Kentucky improved navigation on the Big Sandy and its Levisa Fork between 1835 and 1838 by removing boulders and snags and blasting narrow pushboat chutes through shoals. Virginia chartered the Tug Fork Navigation Company in 1853 to improve navigation upriver into the portion of Logan County which later (1895) was split off to form Mingo County, and chartered the Virginia and Kentucky Navigation Company in 1858 to build a slackwater project up Big Sandy in cooperation with the Kentucky-chartered Big Sandy Company, but these companies were not successful and in 1870 Kentucky spent $75,000 of state funds clearing Levisa Fork and widening the channel chutes to fifty feet.

The Kentucky open-channel navigation work did benefit river traffic. It will be recalled that a Union army commanded by Colonel James A. Garfield was supplied by steamboats from Catlettsburg to Pikeville on Levisa Fork in 1862. By 1874 the steamboat *Fleetwing*, one of the Big Sandy "batwing" steamers, was plying the river up to Pikeville five months in every year and Big Sandy pushboats and steamers were moving 30,000 passengers and 30,000 tons of commodities yearly.

Congress in 1874 approved a survey of the Big Sandy up to the two forks at Louisa, Ky., Tug

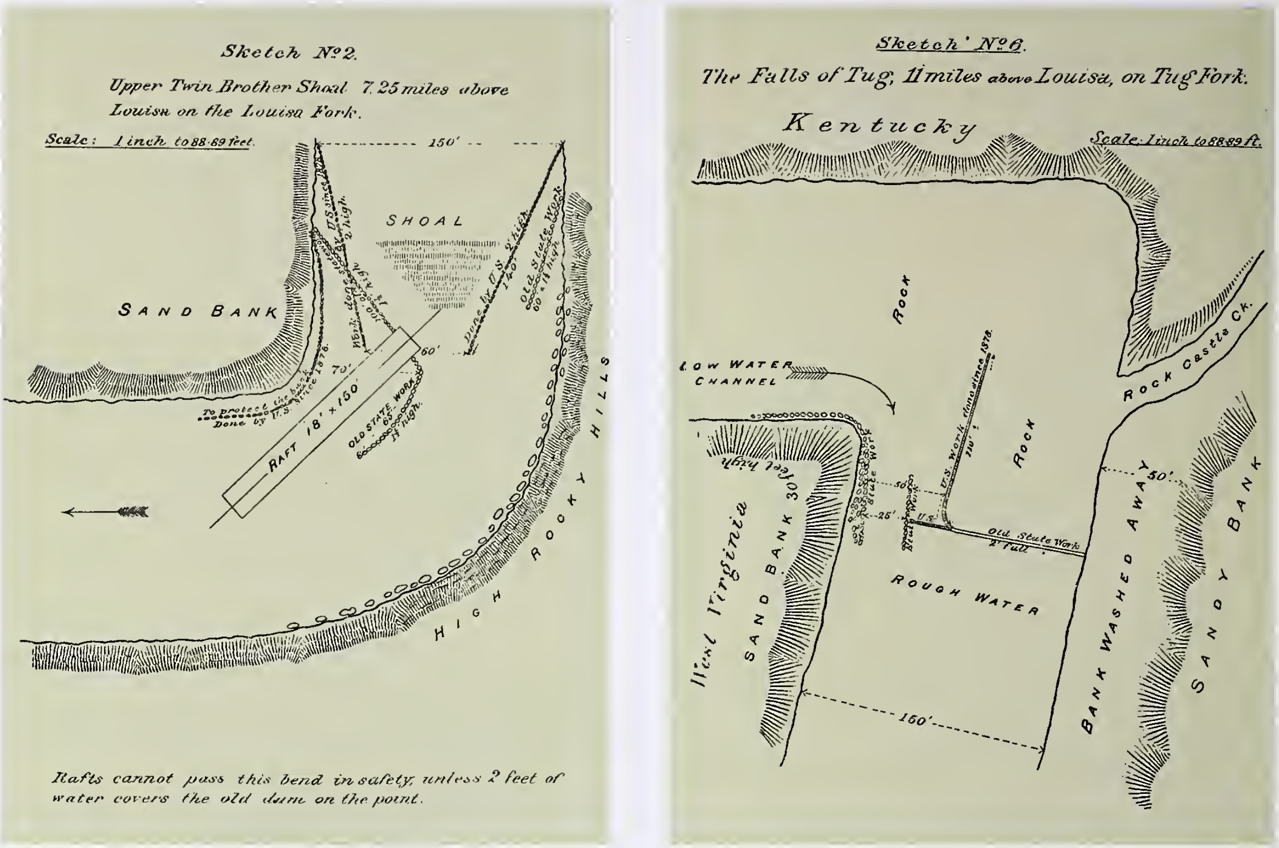


Pushboats on the Big Sandy River. There used to thousands of these on the river. They began to disappear about 1885, and were practically all gone at the beginning of this century.



—Robert E. "Bob" Kennedy Photo Collection

Log rafts on the Big Sandy River.


Sketch No 2.
Upper Twin Brother Shoal 7.25 miles above Louisa on the Louisa Fork.
Scale: 1 inch to 88.69 feet.
150'
SHOAL
SAND BANK
U.S. since 1878 2' high
Work done since 100' 11' high
Done by U.S. 2' high 140'
Old State Work 60' x 11' high
70'
60'
To protect the bank Done by U.S. since 1878.
RAFT 18' x 150'
OLD STATE WORK 65' 11' high.
HIGH ROCKY HILLS
Rafts cannot pass this bend in safety, unless 2 feet of water covers the old dam on the point.
Sketch No 6.
The Falls of Tug, 11 miles above Louisa, on Tug Fork.
Kentucky
Scale: 1 inch to 88.89 ft.
ROCK
LOW WATER CHANNEL
U.S. Work done since 1878. 110'
ROCK
Rock Castle Ck.
feet high
SAND BANK 30
West Virginia
Old State Work
50'
25'
U.S.
Old State Work 2' Fall
ROUGH WATER
50'
BANK WASHED AWAY
SANDY BANK
150'

Drawings from Chief of Engineers' Annual Report, 1880, showing improvements by Colonel Merrill.

Fork to Warfield, Ky., and Levisa Fork to Pikeville, Ky. Colonel Merrill found a large steamboat, flatboat, and pushboat traffic on the Big Sandy and a heavy commerce in rafted logs floating downriver from points even above the Virginia state line, despite nearly unnavigable conditions at low water and dangerous torrents at high water. Coal mining along the two forks had been abandoned because of disasters incurred by coalboats attempting to descend the river. Merrill recommended clearing upper sections of Tug and Levisa forks of obstructions and blasting wider chutes for log-raft and pushboat navigation and building locks and dams to open access to the rich coalfields in the basin. He thought twenty-two locks and dams might be necessary: three to canalize the Sandy from Catlettsburg to Louisa; thirteen on Levisa Fork to Pikeville; and six on Tug Fork to Warfield.

Congress first approved the open-channel improvement of Tug and Levisa forks, and Merrill sent Engineer crews up the forks in pushboats to areas where the only available transportation was by packmule.

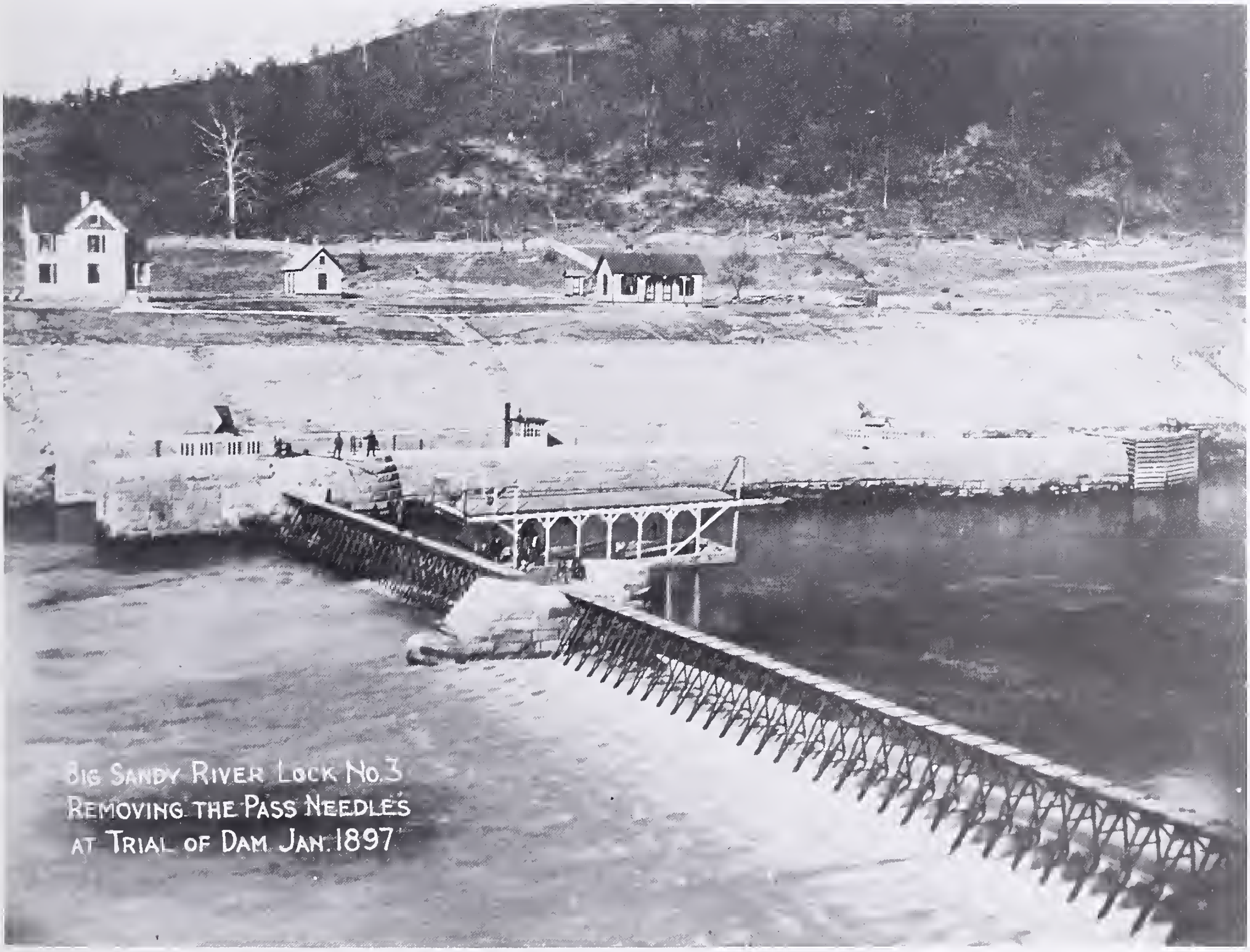
The Roughs of the Tug at the West Virginia-Virginia state line was a five-mile section of Tug Fork where boulders fallen from overhanging cliffs had so obstructed the channel that not even log rafts could pass. Engineer work parties began at the state line and waded downstream, blasting huge stones to bits without bothering to drill and tossing the fragments out of the channel. By 1882, after two work seasons, a twenty-foot wide channel was open on Tug Fork through the Roughs, pushboats were taking supplies upriver into Virginia, and log rafts were floating out, thereby opening the region to a new income source. Similar work with similar results was performed on Levisa Fork to near the Kentucky-Virginia state line.

Construction of the Big Sandy slackwater project began in 1883 with Lock and Dam 3, just below the juncture of the two forks at Louisa, to furnish a convenient harbor for coalboats and other watercraft. Funding was meager and the lockwalls and abutments were not finished until 1890.

When construction of the fixed, timber-crib dam began in 1890, timber-rafters and coal mine operators raised loud objections. They wanted movable dams like those on the Kanawha, to open a channel for navigation at high water without lockage. The Engineers discovered the Big Sandy had a unique, unstable hydrology, with immense volumes of sand incessantly moving downstream, and they feared that a fixed dam might create a sand flat instead of slackwater, but the low flow of the Sandy was sometimes as little as twenty cubic feet per second (cfs). Movable Chanoine wicket dams, with gaps between the wickets, like those on the Kanawha and Ohio rivers, could not work on the Sandy because too much water escaped through the gaps for a slackwater pool to be maintained.

The solution was devised by expert waterways engineer Benjamin F. Thomas, an Ironton, Ohio, native, who had been chief engineer of the Chattaroi Railroad, along Big Sandy valley, before his appointment in 1883 as assistant engineer in charge of the Big Sandy project for the Corps. Thomas visited Europe to inspect the movable dams built by the French engineers. On his return he suggested that the movable, yet watertight, Poiree needle dams he saw on French and Belgian rivers might be worth trying on the Big Sandy. General William P. Craighill and a board of engineers thought it an excellent idea, provided Thomas could modify the dams for the special conditions of Big Sandy hydrology, and in 1892 approved construction of an experimental Poiree needle dam at No. 3 on the Sandy.

Poiree needle dams were formed of metal trestles that collapsed sidewise on the dam foundations at high water and were raised when the river fell. When the trestles were raised, a walkway was laid across them and men moved along the top of the trestles, sliding wooden boards—


Big Sandy River Lock No. 3
Removing the Pass Needles
at Trial of Dam Jan. 1897

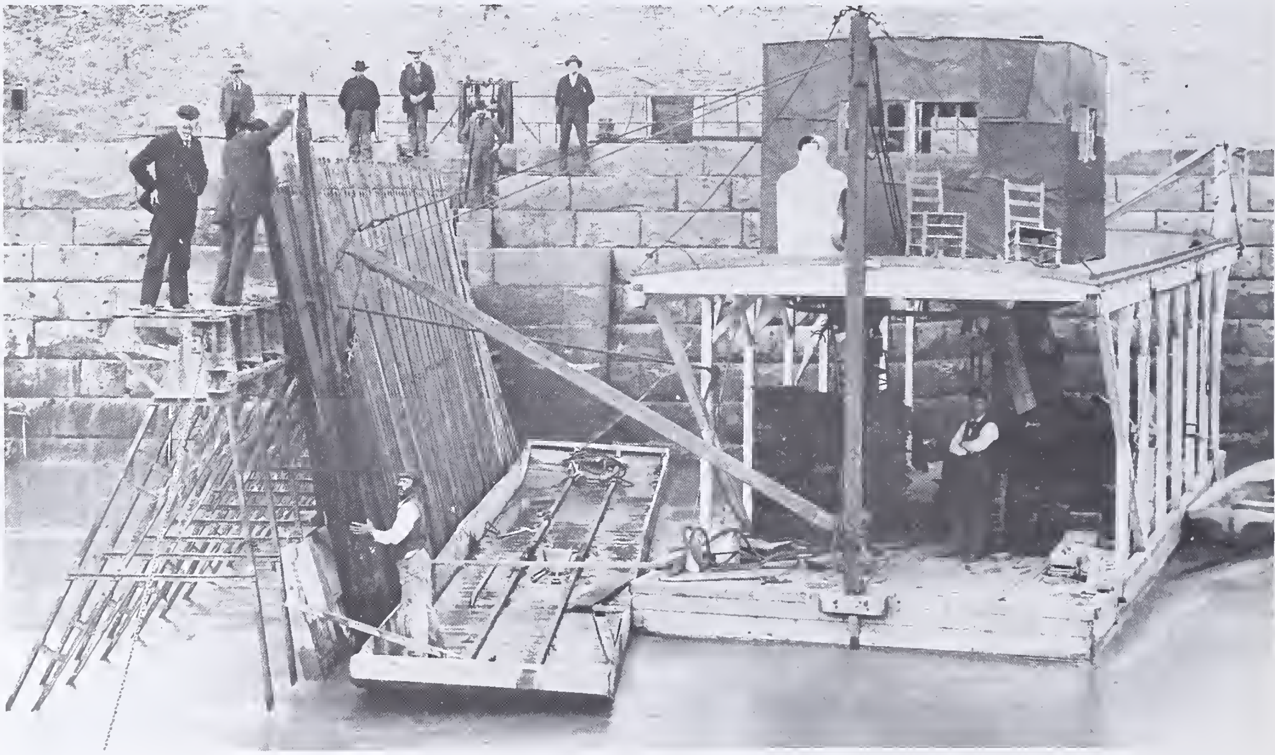
Lock and Dam No. 3, Big Sandy River, first dam in the construction of the Big Sandy slackwater project begun in 1883. This photograph shows removing the pass needles at trial of dam in January 1897.

"needles"—down by hand to rest against the upstream face of the trestles to form the dam. French engineers had built needle dams to maintain an eight-foot pool. Benjamin Thomas designed the Louisa Dam (No. 3) on the Big Sandy River to hold a thirteen-foot pool, making it the highest needle dam in the world. Trestles on the French and Belgian dams had been raised into place one-by-one by hand; Thomas devised a continuous chain system, powered by a steam winch, to raise the trestles with a single effort.

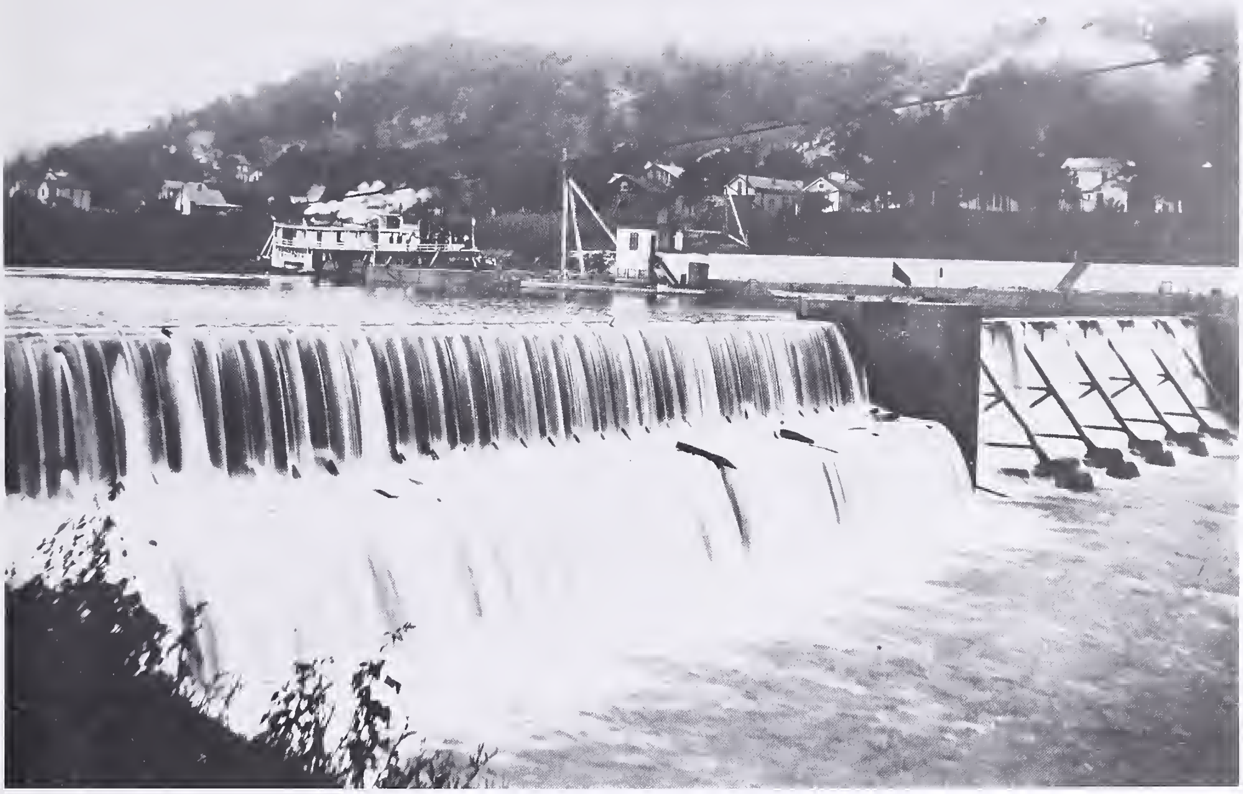
The Louisa needle dam, completed on New Year's Day of 1897, had thirty-one trestles in the navigable pass and thirty-four trestles in the weir section. The needles were 12-inch-wide white pine boards, 14 feet 3 inches long, with iron handles at the top of each needle. Needles on the French dams had been placed on the trestles by hand; Thomas utilized steampower on a needleboat to raise the needles above the trestles and drop them into place. Because Big Sandy floods rose quickly to crests forty and fifty feet above low-water stages, Thomas also rigged "escape" devices to drop several needles into the river simultaneously and open the dam to pass the flood waters.

While planning and building the Louisa Dam, Thomas and his assistant, David A. Watt, studied movable dams and waterway engineering around the world. The two men eventually published a two-volume study of locks, dams, and waterways structures which became a standard reference work for the Corps of Engineers and waterway engineers everywhere. Benjamin Thomas became a sort of roving engineer, sent by the Corps to waterway projects that were not progressing because of engineering or construction difficulties; he invented several other movable dam types, like the A-Frame dams, that were used effectively on other inland rivers.

By the time Thomas completed the Louisa Dam in 1897, coal mining, stimulated by railroads slowly building into the Big Sandy basin, had begun on a large scale, hundreds of log rafts were running out of the river to Catlettsburg at every flood, and the tiny steampowered "batwings" on the river were doing a thriving business. In a report to Congress in 1898, Thomas declared "the Wealth of the Big Sandy Valley is not now in its farms or its timber, but in its coal," and he recommended swift construction of twenty more locks and dams to open the Sandy to coal barge traffic: ten would be required to create a slackwater channel up Levisa Fork to Pikeville, eight on Tug Fork up to the mouth of Pond Creek, and two (Nos. 1 and 2) to canalize the Sandy from its



Placing needles on shelves at Lock and Dam No. 3 on the Big Sandy River. Benjamin Thomas standing on extreme left.



Lock and Dam No. 1, Big Sandy River, supporting a total head of 21 feet taken at low water stage, with the dam completed in 1905. The steamer "Enquirer" is in the lock.

mouth up to Louisa Dam (No. 3). Congress adopted the slackwater project in its entirety in 1899.

Locks 1 and 2, with Poiree needle dams, were completed at Catlettsburg and Kavanaugh, Ky. on the main stem of the Big Sandy by 1905, and Lock and Dam 1 on Tug Fork and Lock and Dam 1 on Levisa Fork just above Louisa were in operation by 1909. This was a fairly swift construction rate, but by 1909 the Norfolk and Western Railroad had long since completed a main line along Tug Fork and the Chesapeake and Ohio Railroad had built along Levisa Fork into Pikeville. Log rafting on the forks and the Big Sandy continued, but profitable steamboat service ended with completion of the railroads. The needle dams operated satisfactorily, but the slackwater system as a whole was in trouble because the Ohio River dam below the mouth of the Sandy was not completed, making it difficult for boats to enter the Big Sandy slackwater at low water stages, and because sand filled the lock chambers and approaches after every Big Sandy flood. Navigation on the Big Sandy slackwater was sometimes suspended for days and weeks while the Engineers worked with shovels, scrapers, force pumps, dredges, and every conceivable device to clear the locks for operation.

Major Lewis H. Rand, Cincinnati District Engineer, requested authority in 1912 to pull the needles and throw the Big Sandy dams down permanently. There was virtually no boat traffic on the river, Rand said, to justify the cost of operation—all the lockmen were doing was opening the gates occasionally to lock sand downriver. The board of engineers met at Catlettsburg in late 1912 to investigate; it reported that though the Big Sandy project had merit and promised success if it were continued far enough upriver to reach the coalfields, existing commerce was negligible, river conditions were unfavorable for locks and dams, and the cost of building up to the coalfields would probably exceed benefits.

The Big Sandy slackwater project was much like a bridge built halfway across a river and then abandoned. Construction ended in 1914 and was never renewed, though active support for extending the project up to the coalfields continued for another half century. Despite the precedent-breaking engineering employed on the project, the Corps of Engineers was defeated on the Big Sandy by billions of sand grains and pebbles and the opposition of the railroads to the project. More than a million dollars had been spent in building the Big Sandy locks and dams, but few benefits were ever realized.

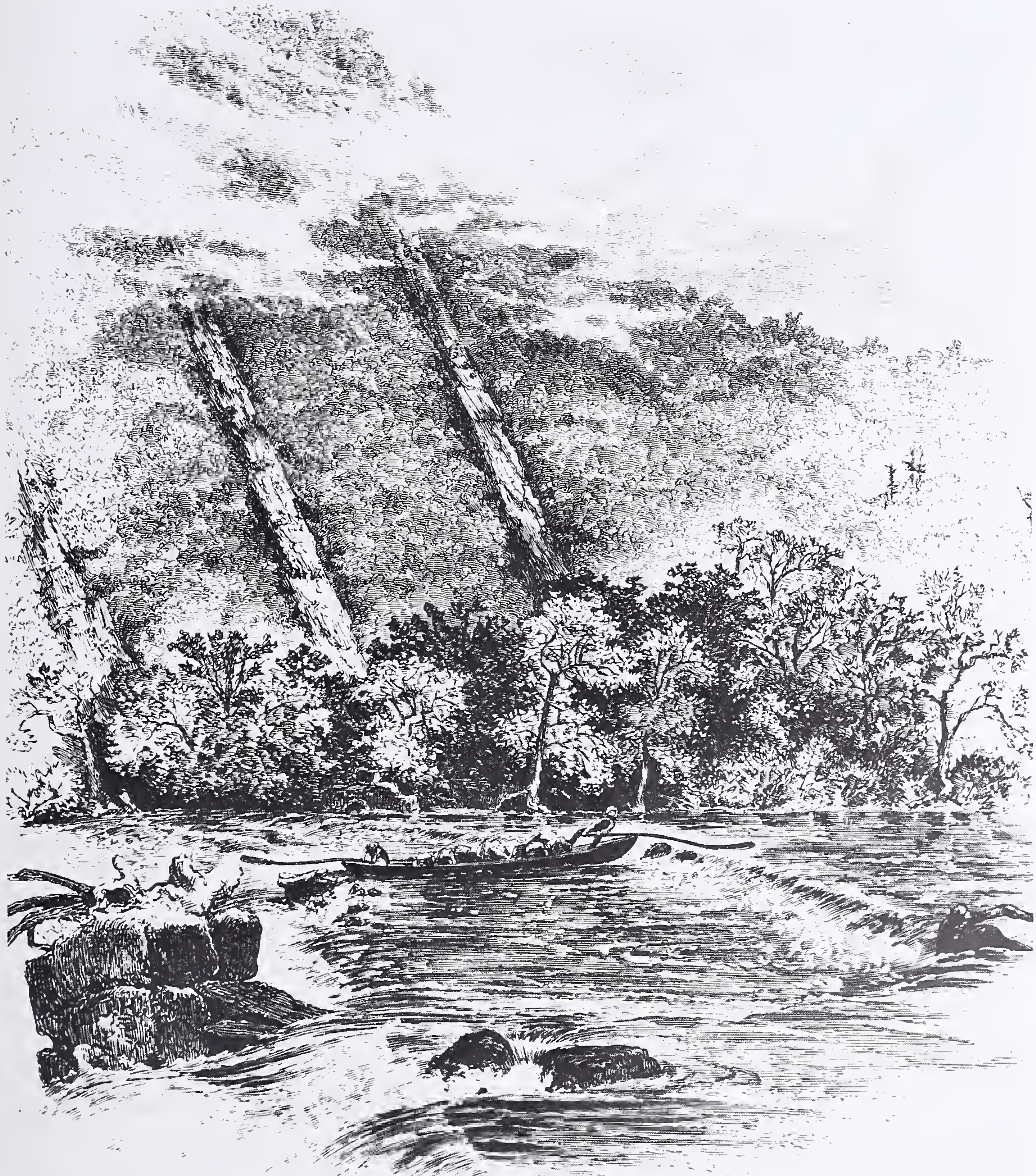
On the other hand, the small sums spent in clearing the upper Tug and Levisa forks for log raft and pushboat navigation rewarded the Engineers' efforts with immediate benefits, doubling and tripling commercial use of the rivers. The same was true of many other streams improved for small boats and log rafts. Colonel Merrill said that clearing streams for a log-rafting commerce provided public benefits that fully justified the projects: "To assist in bringing this timber to market is to increase the national wealth, as otherwise a large part of this particular product will mature and decay without benefit to anyone." Critics were apt to describe them as the worst of the "pork barrel" projects, but the open-channel improvement of such streams as the Guyandotte and New rivers was very worth while.

Efforts to Improve New River

The lower course of New River, below the mouth of the Greenbrier, had been studied before the Civil War as a section of the proposed James River and Kanawha Canal, and the upper course of the New in Virginia had been improved by the Confederates for military supply and grain shipments in small craft. When General William P. Craighill examined the New River during his study of the Central Water Line in 1872, he found "New River bateaux" navigating various section of the stream to supply isolated settlements. General Craighill recommended improvement of New River from the lead mines in Wythe County, Va., to the mouth of the Greenbrier River at Hinton, W. Va. In 1876 Congress approved a project to blast thirty-foot-wide and two-foot-deep chutes through New River shoals to assist bateau navigation.

—Captain Jesse P. Hughes Photo

Steamer "Sea Gull" passing "Cricket and Katie Mack" below Pikeville, Ky., on Levisa Fork, Big Sandy River–1903.



Great Falls, New River.

—*Picturesque America–1872*

Great Falls, New River

Craighill placed Captain James W. Cuyler, Corps of Engineers, in charge of the New River project, and in 1877 Cuyler built flatboats, keelboats, and canoes for a working party at New River Depot, Va., across from Radford, and set off downriver. Standing in swift waters, the workmen pounded holes into the rocky channel with heavy hand drills, resembling crowbars, which they worked by jumping them up and down in drill holes. When the holes were about three feet deep, tubes of gunpowder were inserted, the fuses were lighted, and the men ran for cover. Blasts rocked the earth, rock fragments flew up and cascaded back into the river, and the men cautiously returned to the river, for gunpowder was not always predictable. By hand and by simple cranes on flatboats, the broken rock was moved and shoveled into piles alongside the channel to form wing dams and walls, forcing the low water flow of the river through the channel chutes.

The New River project required a great deal of tiresome and dangerous hand labor, while standing in swift water, but the men were willing to work for 10 cents a day plus daily rations of a pound of pork, a pound of sugar, two pounds of cornmeal, coffee, and vegetables. It was necessary, however, to raise wages to 25 cents a day after cold weather set in and icy waters began to roll down the New River, to keep a full workcrew in the river. The dangers of working in the channel of a flood-prone stream like the New, where in many places precipitous cliffs bordered the stream, were great. Captain Cuyler and his men were blasting chutes above Hinton on September 13, 1878, when a terrific flood, five to seven feet higher than any previously known high water, roared down the narrow gorge, forcing the Engineers to abandon their tools and scramble up the cliffsides to safety. Their camp in the gorge was wiped out, their workboats swept away, and the working season was abruptly ended.

During the 1879 working season Captain Cuyler was replaced on the New River project by Colonel William Proctor Smith, a former officer of Topographical Engineers and an engineer on the staff of Confederate General Robert E. Lee. As directed by Congress, Colonel Smith extended the improvement of New River above the Austinville lead mines up to the North Carolina line. Overall, the New River improvements were divided into three divisions. Work on the lower or Greenbrier Division was aimed at opening New River for steamboat and bateau traffic from Hinton to Tazewell Road, twenty-seven miles above Hinton, thereby opening a route to market for the timber and farm produce of Tazewell, Mercer, and Monroe counties to the Chesapeake and Ohio Railroad at Hinton. Work on the middle or New River Bridge Division opened navigation for shipments of iron from the iron furnaces, thirty miles upriver, to the Norfolk and Western Railroad at New River Bridge (Radford). Work on the upper or Lead Mine Division was designed to open a channel from North Carolina to Austinville, permitting the floating of timber and charcoal down to the lead mines.

With the limited funds available, only short, narrow channels were blasted open for commerce. The total footage drilled into the bed of New River equalled, if connected, a little under eight miles. But results were immediate. Loggers floated thousands of logs downstream to railroads and furnaces. Isolated mountain communities, formerly dependent on packmules, were supplied with transportation by keelboat lines; and even a few steamboats were built to navigate the new channels. The New River Steamboat Company at Hinton launched the sternwheel steamer *Cecelia Miller* in December 1878 and ran it from Hinton up to Tazewell Road. The 100- by 20-foot boat was too large for the narrow chutes and efforts to use it in the Tazewell Road commerce were abandoned, but the boat operated as an excursion boat at Hinton for several years before it was wrecked in a New River flood. Standard Oil Company also operated a 75- by 10-foot steamer above New River Bridge in Pulaski County for a few years; it brought barrel staves for the petroleum business downriver to the railroad for trans-shipment.

The value of the New River project was reduced by railroads slowly building through the valley, and at General Craighill's recommendation the improvement of New River navigation was ended in 1884. Congress made another appropriation for the New River in 1886, which was partly spent in clearing the old chutes, but General Craighill reported further improvement of New River would be "of no value whatever," and the remainder of the appropriation was returned to the Treasury. Craighill explained the project had been limited to efforts to "increase facilities for access of the greatest number to the railroads touching the river, and thus connecting with the eastern and western markets districts otherwise isolated and hitherto dependent on teaming to railroad stations over long and bad roads." This goal was accomplished at minimum cost, and when more railroads were built the project was abandoned.

Pork Barreling the Guyandotte

The little Guyandotte had a similar "pork barrel" project during the last quarter of the nineteenth century. Because railroads were not built into the Guyandotte basin until about 1900, Guyandotte River navigation was vital to the region: timber and produce were shipped out by

—Jack Custer Photo Collection

Log rafting on the Guyandotte River at Huntington, W. Va.

river and commodities were brought in on pushboats, a kind of bateau up to eighty feet long and seven feet wide propelled upriver by men with iron-tipped poles, keelboat-fashion. Pushing boats up the obstruction-cluttered Guyandotte was tiresome work, but nevertheless much easier than using the nearly impassable trails, which were the only other means of travel and transport.

Congress approved a survey of the Guyandotte in 1874, and Colonel Merrill selected Arthur L. Cox of Barboursville to examine the stream. Cox found the river enchanting: "The scenery is, indeed, noble," he said, "and in full autumnal tints the long sweep of forest-clad mountain presents to the traveler's eye an ever-varying picture of surpassing beauty." Only vestiges of the lock and dams built on the river before 1861 remained, but Cox learned that about $400,000 worth of farm and forest produce floated out of the river annually and about 300 tons of merchandise were shipped upriver in pushboats and small steamers from the wharfboat at the village of Guyandotte. He saw rich coal veins near Logan Court House, from which coal might be profitably mined and barged to Ohio River markets; and he recommended canalization of the river up to Logan by construction of fifteen locks and dams for barge navigation. Colonel Merrill, however, thought the costs of a slackwater project would be exorbitant and recommended, instead, clearing the stream to aid log-rafting and pushboat navigation.

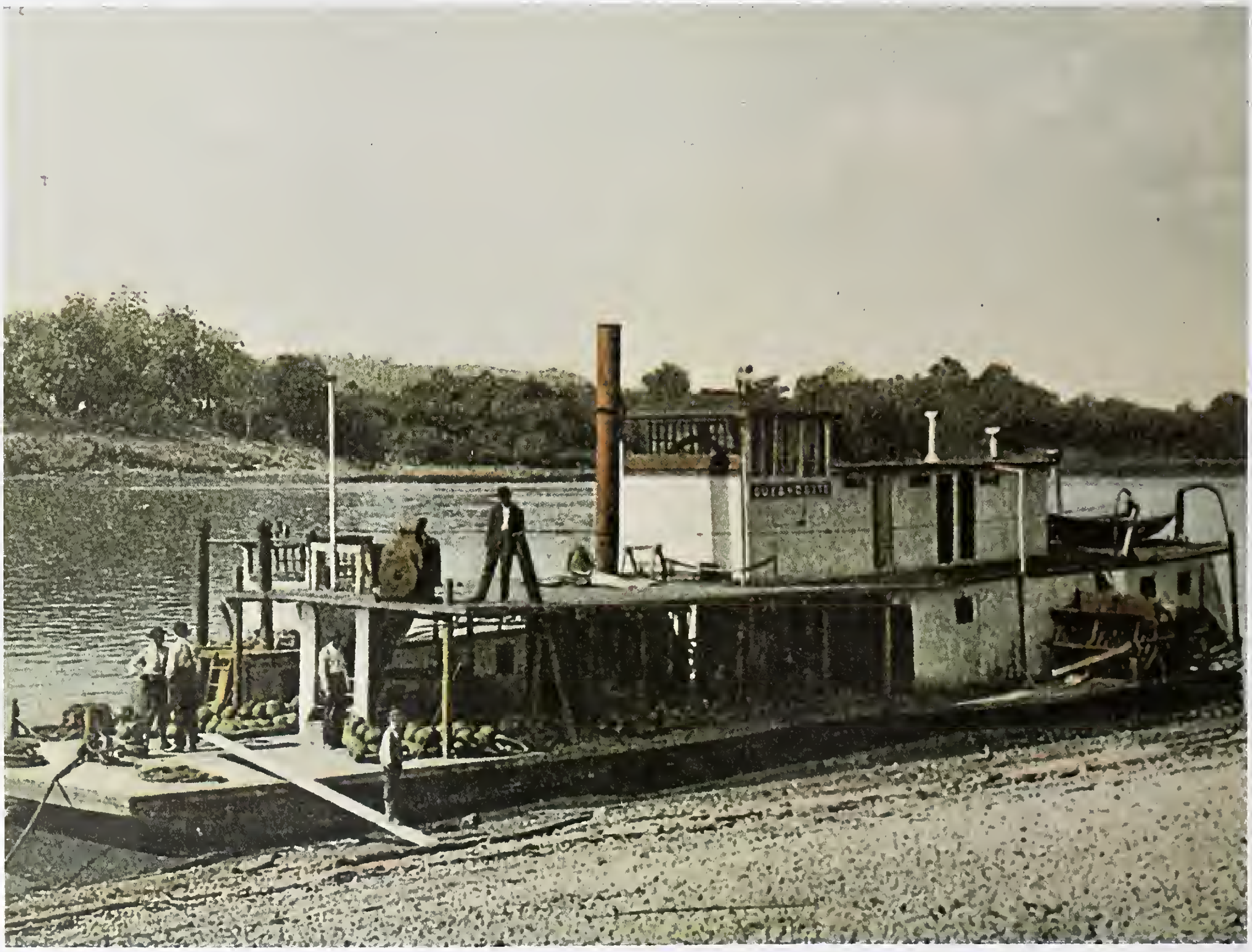
With funds provided in 1878, Colonel Merrill dispatched a small crew in a pushboat to clear away the ruins of the old dams; and for the next twenty years Engineer parties forced their way up the Guyandotte in pushboats annually to clear and maintain a thirty-foot wide and eighteen-inch deep channel to a point about forty miles above Logan. Crews of twelve to twenty-five men poling pushboats moved up- and downstream, removing snags with dynamite and axes, dragging boulders and loose stone from the channel, and piling rock in training walls alongside chutes. The effects of this primitive work were apparent by

1883. Congressman John E. Kenna of West Virginia said in that year that before the Engineers went to work on the stream about 20 percent of the log rafts were lost each year while descending the Guyandotte, but in 1883 timber worth $50,000 was shipped a hundred miles down the river by one lumber firm without loss of a single log. Many sawmills had begun operation by 1883, along the river above Logan because of the improved navigation, and huge rafts of logs and shipments of feathers, ginseng, and tobacco worth more than a million dollars were annually floating the stream.

The improved channels enticed rivermen to put steamboats on the river: the *J.T. Hustler*, *Jennie George*, *Favorite*, *Edward C. Kirker*, *Sadie E.*, and *Guyandotte*. All were tiny boats, but they saved the labor of poling bateau upriver. Captain Godbey even succeeded in steaming his little *Guyandotte* all the way to Logan on the crest of one of the higher Guyandotte floods.

After channels were cleared, the major obstructions to Guyandotte navigation were the private milldams which crossed the stream at several points. Boats and rafts had to jump the dams at high water, or lift cargo over the dams into other boats at low water; and several Guyandotte log-rafters lost their lives while crossing the dams. The Corps of Engineers was unable to do anything about the milldams until Congress enacted a law to prevent such obstruction of navigable streams in the River and Harbor Act of 1899, but by that date it was too late to be of much benefit to Guyandotte River commerce.

Logging and rafting was the principal industry in the Guyandotte basin until the turn of the century, and log rafts were the most important traffic on the stream. On a "log tide" rise, the intrepid raftsmen set out on their wild downriver ride, steering and bending the rafts down the serpentile channel with long oars at "bow and



Steamboat Photo Collection of G. W. Sutphin

Steamer "Guyandotte." Typical of "Bat-wing" boats that ran on the Guyandotte River.

stern." Men who fell overboard, if not superb swimmers, were carried away by the flood-swollen stream or trapped under the raft and drowned. If rafts were not broken on rocks or snags, or smashed while jumping a milldam, they reached the village of Guyandotte in two to three days, where the logs were sold to sawmills or to dealers who shepherded "fleets" of log rafts down the Ohio with steamboats to Cincinnati and other ports. Rafters collected their pay, enjoyed a "spree" at Guyandotte or Barboursville, and made a long walk back up the valley to home.

Log rafting on the Guyandotte was doubtless quite an adventure, but more important were the facts that the commerce provided the mountaineers with scarce cash income, ended the isolation of the upper Guyandotte valley, and tied the region into the national economy.

Henry C. Ragland, newspaper editor at Logan, launched a campaign in 1894 to get Congress to approve a slackwater project for the Guyandotte, and the following year Congress authorized a survey. But the Engineers reported that twelve expensive locks and dams would be necessary to canalize the stream to Logan, and at low water the flow of the river was insufficient even for lockage. With the hopes of a slackwater project dashed, businessmen of Huntington, led by James L. Caldwell of Huntington National Bank, organized the Guyandot Valley Railroad and began construction from Huntington up the valley to Pineville in 1900. The line, merged with the Chesapeake and Ohio system in 1903, reached Logan in 1904. When the first train pulled into Logan on September 9, 1904, its whistle sounded the death knell of Guyandotte River commerce. Logs continued to float to market, but work on the navigation project ended.

Prior to 1899, the Engineers had expended $22,689.90 on the Guyandotte, resulting in relatively more direct benefits in increased safety, lower-cost transportation, and economic development than the expensive slackwater projects on streams like the Muskingum ever provided. Colonel Merrill said in 1888 the small sums expended on rafting streams in the Ohio basin were producing relatively larger returns than were the vastly greater sums spent to build slackwater projects for steamboat navigation.

The Pork Barrel Restrained

Reform of the "pork barrel" began during the administration of President Theodore Roosevelt, with the creation of the Board of Engineers for Rivers and Harbors (BERH) to pass on all proposed waterway projects. This board disapproved about 70 percent of all waterway projects it studied, leading to the comment by General Douglas McArthur that the reputation of the Corps of Engineers in civil works rested not on what it built, but what it did not build. The improvement of streams like Guyandotte, New, Hocking, Elk, and Gauley rivers ended just after the turn of the century, and funds previously expended on these and other rafting streams were funneled into an accelerated construction program on rivers like the Ohio, but public opposition prevented closing the slackwater projects on the Muskingum, Little Kanawha, and Big Sandy rivers for many years after their usefulness to commercial navigation had ended.

Upper Guyandotte River as it is today.

Chapter VIII

Huntington District and Canalization

With a light but precious cargo in the covered cement barge ahead, Captain Walter Johnson made good speed during the voyage down the Ohio from Wheeling, sometimes, on the slackwater pools, letting the *James Rumsey* race downriver at its top speed of thirteen miles an hour.

The *Rumsey,* a unique boat built by Charles Ward at Charleston for Addison M. Scott on the Kanawha project, had twin steam engines driving two four-foot-diameter screw propellers in hull recesses. Captain Johnson had brought it out of the Kanawha and up the Ohio to Wheeling in late June 1922, to load the Engineer records, the office furniture, and the families of the Engineer office staff, along with their household furnishings, for the move to Huntington. Huntington has "scored another victory over its rival city of Wheeling," the Huntington *Advertiser* announced when it learned of the move.

Captain Johnson slowed the throbbing engines as he approached the Huntington wharf, then nosed the *Rumsey* and the barge to bank along the Twenty-sixth Street landing, where lines were tossed to waiting Engineers. When the gangplank was in place, the families aboard made their way to shore and the Engineers began moving the file boxes and office furniture from the barge to waiting trucks for movement to the new

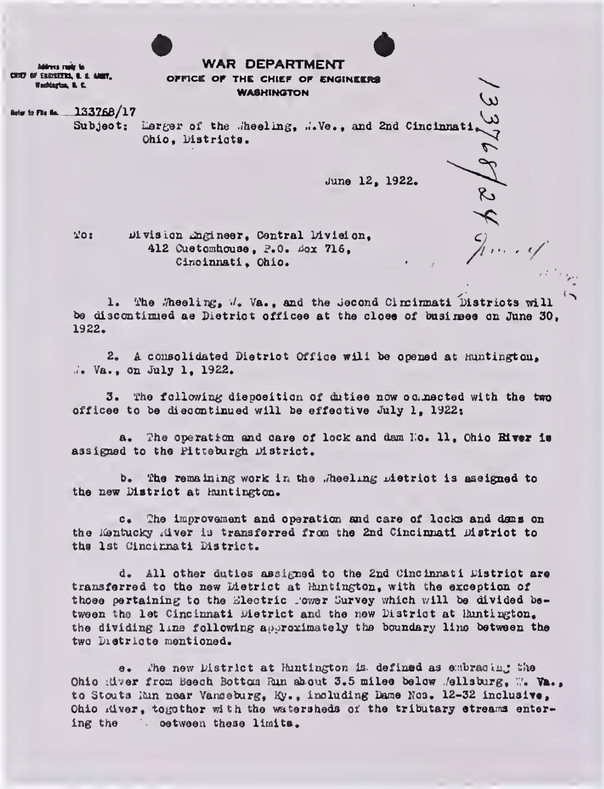
U.S. Steamer "James Rumsey"
Early in July 1922 this boat brought records, office furniture, families and household furnishings to Huntington from Wheeling.

Engineer office in the Deegan and Noonan Building, in the 1100-block of Fourth Avenue.

Thus the Engineers from Wheeling arrived at Huntington on July 11, 1922, completing a move planned the previous March by Central Division Engineer Lansing H. Beach and the Wheeling and Second Cincinnati District Engineers.

The Engineer officers had agreed in March that administrative costs could be reduced by as much as $12,000 a year by merging the Wheeling and Second Cincinnati districts. The Ohio River slackwater project had been completed to a point some distance below Wheeling, and the Second Cincinnati District, created in 1880 to direct projects on tributaries and thereby allow Colonel Merrill and the First Cincinnati District to concentrate on the Ohio River project, was no longer needed.

The question which most concerned the officers was the location of the new consolidated District office. Ohio and Kentucky already had active Engineer District offices, and the Engineers were therefore anxious to keep a District office in West Virginia. Such central valley ports as Marietta and Portsmouth, Ohio, and Catlettsburg, Kentucky, were eliminated from consideration for



Address reply to
CHIEF OF ENGINEERS, U. S. ARMY,
Washington, D. C.

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON

Refer to File No. 133768/17

133768/24

Subject: Merger of the Wheeling, W.Va., and 2nd Cincinnati, Ohio, Districts.

June 12, 1922.

To: Division Engineer, Central Division,
412 Customhouse, P.O. Box 716,
Cincinnati, Ohio.

1. The Wheeling, W. Va., and the Second Cincinnati Districts will be discontinued as District offices at the close of business on June 30, 1922.

2. A consolidated District Office will be opened at Huntington, W. Va., on July 1, 1922.

3. The following disposition of duties now connected with the two offices to be discontinued will be effective July 1, 1922:

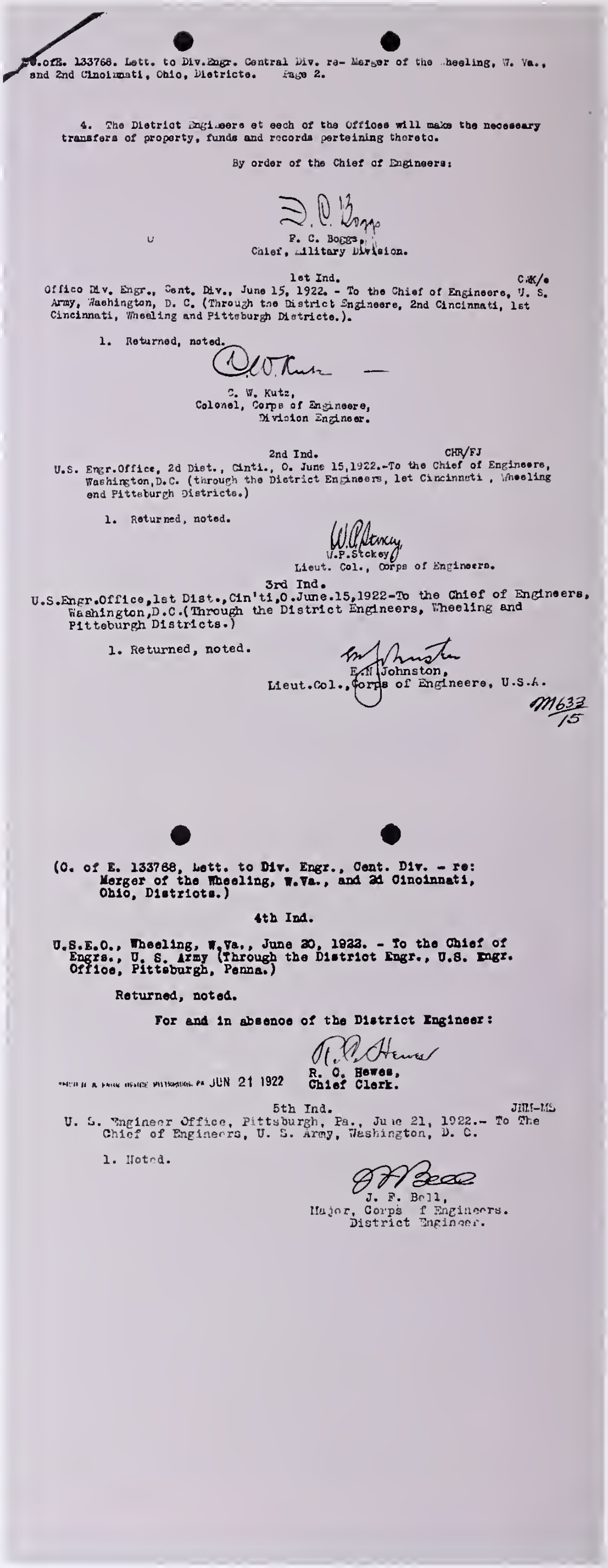
a. The operation and care of lock and dam No. 11, Ohio River is assigned to the Pittsburgh District.

b. The remaining work in the Wheeling District is assigned to the new District at Huntington.

c. The improvement and operation and care of locks and dams on the Kentucky River is transferred from the 2nd Cincinnati District to the 1st Cincinnati District.

d. All other duties assigned to the 2nd Cincinnati District are transferred to the new District at Huntington, with the exception of those pertaining to the Electric Power Survey which will be divided between the 1st Cincinnati District and the new District at Huntington, the dividing line following approximately the boundary line between the two Districts mentioned.

e. The new District at Huntington is defined as embracing the Ohio River from Beech Bottom Run about 3.5 miles below Wellsburg, W. Va., to Stouts Run near Vanceburg, Ky., including Dams Nos. 12-32 inclusive, Ohio River, together with the watersheds of the tributary streams entering the [illegible] between these limits.



O.of E. 133768. Lett. to Div.Engr. Central Div. re- Merger of the Wheeling, W. Va., and 2nd Cincinnati, Ohio, Districts. Page 2.

4. The District Engineers at each of the Offices will make the necessary transfers of property, funds and records pertaining thereto.

By order of the Chief of Engineers:

F. C. Boggs
F. C. Boggs,
Chief, Military Division.

1st Ind. C.K/e

Office Div. Engr., Cent. Div., June 15, 1922. - To the Chief of Engineers, U. S. Army, Washington, D. C. (Through the District Engineers, 2nd Cincinnati, 1st Cincinnati, Wheeling and Pittsburgh Districts.).

1. Returned, noted.

C. W. Kutz
C. W. Kutz,
Colonel, Corps of Engineers,
Division Engineer.

2nd Ind. CHR/FJ

U.S. Engr.Office, 2d Dist., Cinti., O. June 15,1922.-To the Chief of Engineers, Washington,D.C. (through the District Engineers, 1st Cincinnati , Wheeling and Pittsburgh Districts.)

1. Returned, noted.

W.P. Stokey
W.P.Stokey,
Lieut. Col., Corps of Engineers.

3rd Ind.

U.S.Engr.Office,1st Dist.,Cin'ti,O.June.15,1922-To the Chief of Engineers, Washington,D.C.(Through the District Engineers, Wheeling and Pittsburgh Districts.)

1. Returned, noted.

E. N. Johnston
E.N.Johnston,
Lieut.Col.,Corps of Engineers, U.S.A.

M633/15

(O. of E. 133768, Lett. to Div. Engr., Cent. Div. - re: Merger of the Wheeling, W.Va., and 2d Cincinnati, Ohio, Districts.)

4th Ind.

U.S.E.O., Wheeling, W.Va., June 20, 1922. - To the Chief of Engrs., U. S. Army (Through the District Engr., U.S. Engr. Office, Pittsburgh, Penna.)

Returned, noted.

For and in absence of the District Engineer:

R. C. Hewes
R. C. Hewes,
Chief Clerk.

[illegible] PITTSBURGH, PA. JUN 21 1922

5th Ind. JHM-MS

U. S. Engineer Office, Pittsburgh, Pa., June 21, 1922.- To The Chief of Engineers, U. S. Army, Washington, D. C.

1. Noted.

J. F. Bell
J. F. Bell,
Major, Corps of Engineers.
District Engineer.

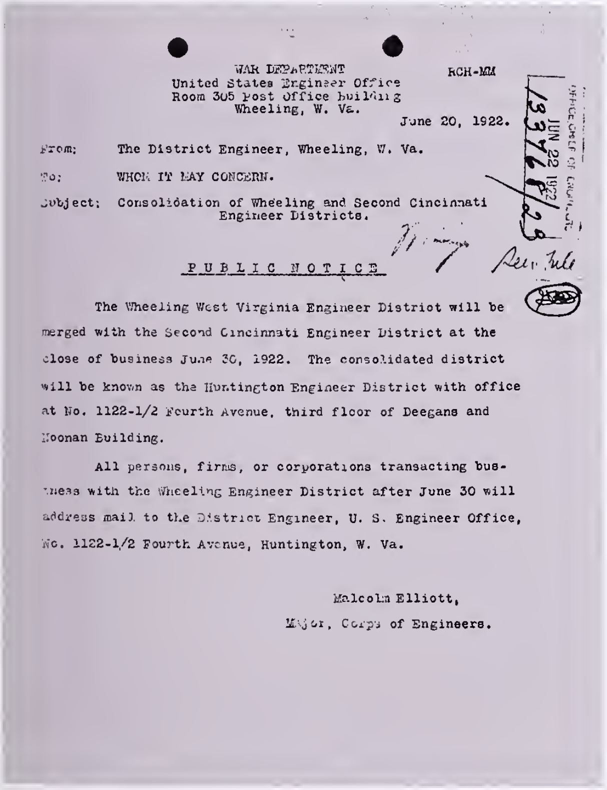
Washington directive merging the Wheeling and Cincinnati Districts, assigning a new district in Huntington, June 12, 1922.

that reason. The choice narrowed to Parkersburg and Huntington, and finally Huntington was selected because it was nearer the Kanawha River, was headquarters for an Army emergency office, was an important railroad point, was headquarters for several big river shipping firms, and because, additionally, shipments of Guyandotte valley coal were making Huntington one of the most important ports on the Ohio.

The officers decided to close the Wheeling and Second Cincinnati districts on the last day of June and open the Huntington District on July 1, 1922, but the move from Wheeling was not begun till after July 1. In the meantime, Benjamin F. Thomas, who (except for service during World War I as Second Cincinnati District Engineer) had directed the Big Sandy slackwater project from suboffices at Louisa and Catlettsburg, Kentucky, moved the Catlettsburg office staff to Huntington and opened the District office for business on July 1. Major Malcolm Elliott, the first Huntington District Engineer, arrived from Wheeling a few days later.

Major Elliott was one of the first District Engineers in the Ohio valley who was not a graduate of West Point. He had been a civilian assistant engineer in the Louisville District prior to 1917 and had been chiefly responsible for the design of swinging mitering lock gates with sufficient structural strength to operate in the very wide Ohio River locks. At the outbreak of World War I Elliott accepted a commission as an officer of the Corps of Engineers. Before his retirement in 1946 he was to serve as District and Division Engineer and as a member of the Mississippi River Commission and the Board of Engineers for Rivers and Harbors. He was one of the earliest advocates of federal flood control and multipurpose water resource projects.

As first Huntington District Engineer, Elliott was responsible for construction and operation of Ohio River Locks and Dams 12 through 32 and slackwater navigation projects on the Muskingum, Little Kanawha, Kanawha, and Big Sandy rivers. He had only twenty-five people in the new District office to assist in supervision and recordkeeping. Most of the staff had transferred from the Wheeling and Second Cincinnati districts. Benjamin F. Thomas remained in charge of the Big Sandy project; Frederick B. Duis from



WAR DEPARTMENT
United States Engineer Office
Room 305 Post Office Building
Wheeling, W. Va.

RCH-MM

June 20, 1922.

OFFICE CHIEF OF ENGINEERS
JUN 22 1922
13376 F/23

From: The District Engineer, Wheeling, W. Va.

To: WHOM IT MAY CONCERN.

Subject: Consolidation of Wheeling and Second Cincinnati Engineer Districts.

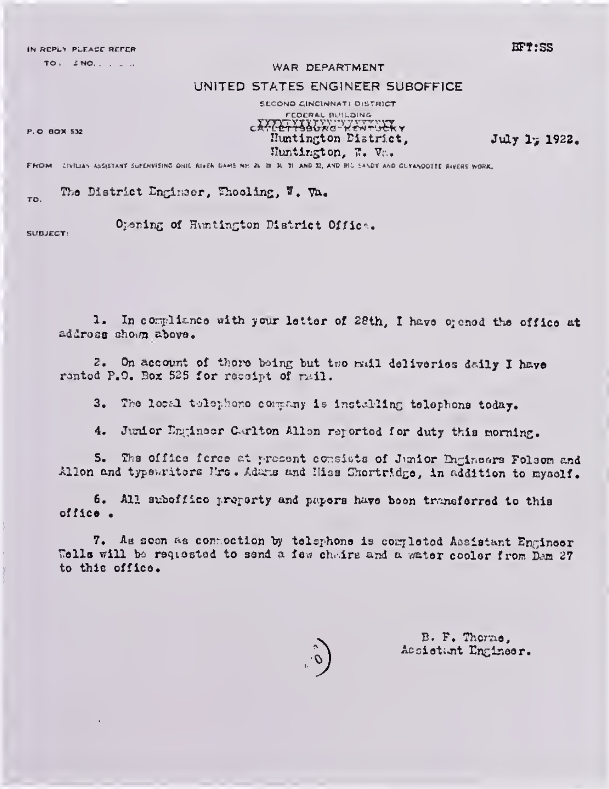
PUBLIC NOTICE

The Wheeling West Virginia Engineer District will be merged with the Second Cincinnati Engineer District at the close of business June 30, 1922. The consolidated district will be known as the Huntington Engineer District with office at No. 1122-1/2 Fourth Avenue, third floor of Deegans and Noonan Building.

All persons, firms, or corporations transacting business with the Wheeling Engineer District after June 30 will address mail to the District Engineer, U. S. Engineer Office, No. 1122-1/2 Fourth Avenue, Huntington, W. Va.

Malcolm Elliott,
Major, Corps of Engineers.

Public Notice that the Huntington Office was open for business.



IN REPLY PLEASE REFER
TO: FILE NO.

BFT:SS

WAR DEPARTMENT
UNITED STATES ENGINEER SUBOFFICE
SECOND CINCINNATI DISTRICT
FEDERAL BUILDING
~~CATLETTSBURG KENTUCKY~~
Huntington District,
Huntington, W. Va.

P. O. BOX 532

July 1, 1922.

FROM CIVILIAN ASSISTANT SUPERVISING OHIO RIVER DAMS NOS. 28 29 30 31 AND 32, AND BIG SANDY AND GUYANDOTTE RIVERS WORK.

TO. The District Engineer, Wheeling, W. Va.

SUBJECT: Opening of Huntington District Office.

1. In compliance with your letter of 28th, I have opened the office at address shown above.

2. On account of there being but two mail deliveries daily I have rented P.O. Box 525 for receipt of mail.

3. The local telephone company is installing telephone today.

4. Junior Engineer Carlton Allen reported for duty this morning.

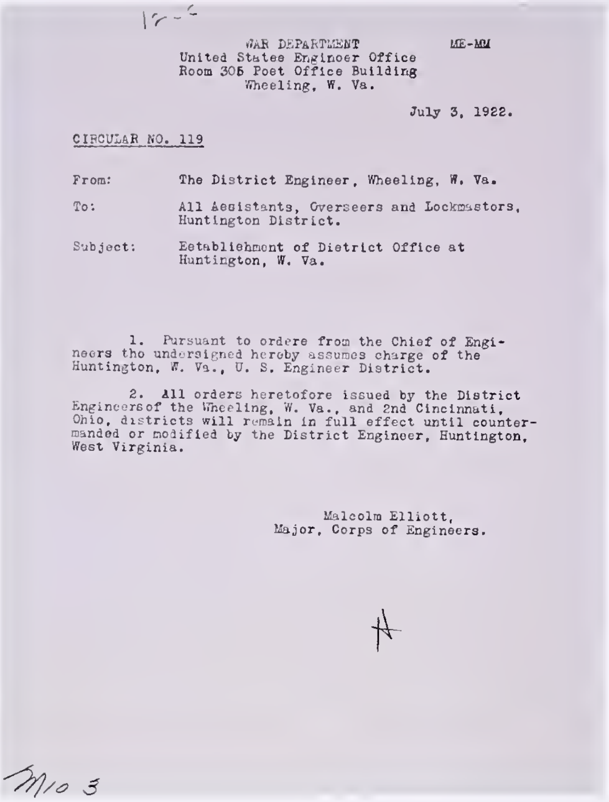
5. The office force at present consists of Junior Engineers Folsom and Allen and typewriters Mrs. Adams and Miss Shortridge, in addition to myself.

6. All suboffice property and papers have been transferred to this office .

7. As soon as connection by telephone is completed Assistant Engineer Wells will be requested to send a few chairs and a water cooler from Dam 27 to this office.

B. F. Thomas,
Assistant Engineer.

Letter to District Engineer, Wheeling District, informing him that the Huntington Office was open.



WAR DEPARTMENT ME-MM
United States Engineer Office
Room 305 Post Office Building
Wheeling, W. Va.

July 3, 1922.

CIRCULAR NO. 119

From: The District Engineer, Wheeling, W. Va.

To: All Assistants, Overseers and Lockmasters, Huntington District.

Subject: Establishment of District Office at Huntington, W. Va.

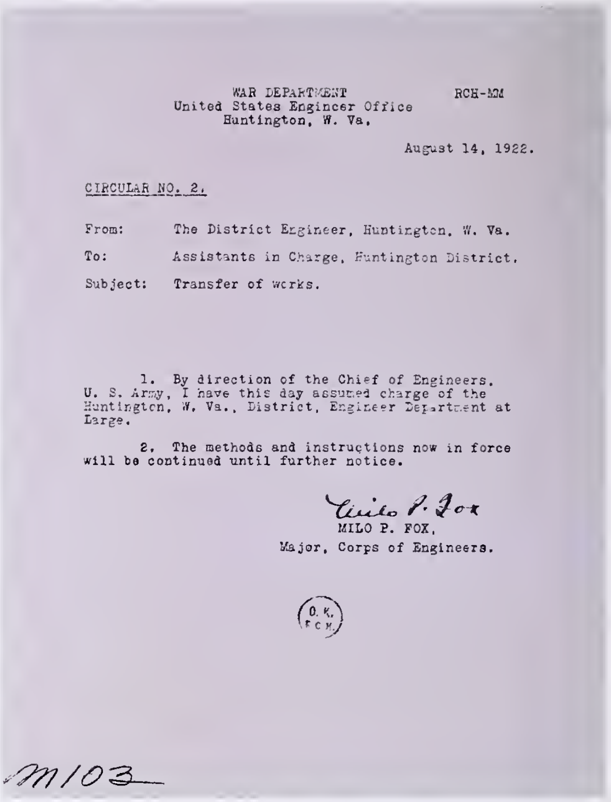
1. Pursuant to orders from the Chief of Engineers the undersigned hereby assumes charge of the Huntington, W. Va., U. S. Engineer District.

2. All orders heretofore issued by the District Engineers of the Wheeling, W. Va., and 2nd Cincinnati, Ohio, districts will remain in full effect until countermanded or modified by the District Engineer, Huntington, West Virginia.

Malcolm Elliott,
Major, Corps of Engineers.

M10 3

Circular orders from Major Malcolm Elliott, the first District Engineer of the new Huntington District, informing all employees that he was assuming command.



WAR DEPARTMENT RCH-MM
United States Engineer Office
Huntington, W. Va.

August 14, 1922.

CIRCULAR NO. 2.

From: The District Engineer, Huntington, W. Va.

To: Assistants in Charge, Huntington District.

Subject: Transfer of works.

1. By direction of the Chief of Engineers, U. S. Army, I have this day assumed charge of the Huntington, W. Va., District, Engineer Department at Large.

2. The methods and instructions now in force will be continued until further notice.

Milo P. Fox
MILO P. FOX,
Major, Corps of Engineers.

O. K.
R C H.

M103

Directive transferring command of the Huntington District to Major Milo P. Fox.

Wheeling became Principal Engineer at Huntington; Reginald C. Hewes became chief clerk; Harry N. Robinson became chief of finance; Charles H. Clendenning became chief file clerk; Mary Rose Connelly Thomas handled property accounting; and S.J. Ritchey, former chief clerk to General John J. Pershing, was responsible for purchasing and contracts.

As had been expected when consolidation was planned, several members of the Wheeling and Cincinnati District staffs retired or resigned rather than transfer. One was Guy B. Bebout, assistant engineer at Wheeling, who invented Bebout wickets in 1908. Bebout wickets resembled Chanoine wickets, but were designed to trip automatically at certain river stages, an advantage which was offset by the fact that they were also tripped by waves from passing boats. Bebout left the Engineers in 1922 to enter the coal and sand and gravel business on the Muskingum River.

The formation of the Huntington District was accompanied by several administrative changes. The Catlettsburg suboffice, responsible for the Big Sandy project, was closed; the Charleston suboffice on the Kanawha, directed by Assistant Engineer Thomas E. Jeffries since Addison Scott's dismissal, was closed; and the suboffice at Zanesville on the Muskingum was closed. Assistant Engineer Edmund Moeser had directed Muskingum River operations from the Zanesville office since the Merrill era; he moved in 1922 to new offices at the Marietta Repair Station, established in 1920 in buildings once occupied by the A.T. Nye Stove Works to build small craft, service the Engineer fleet, and operate as a central supply depot.

A Major Canalization Program.

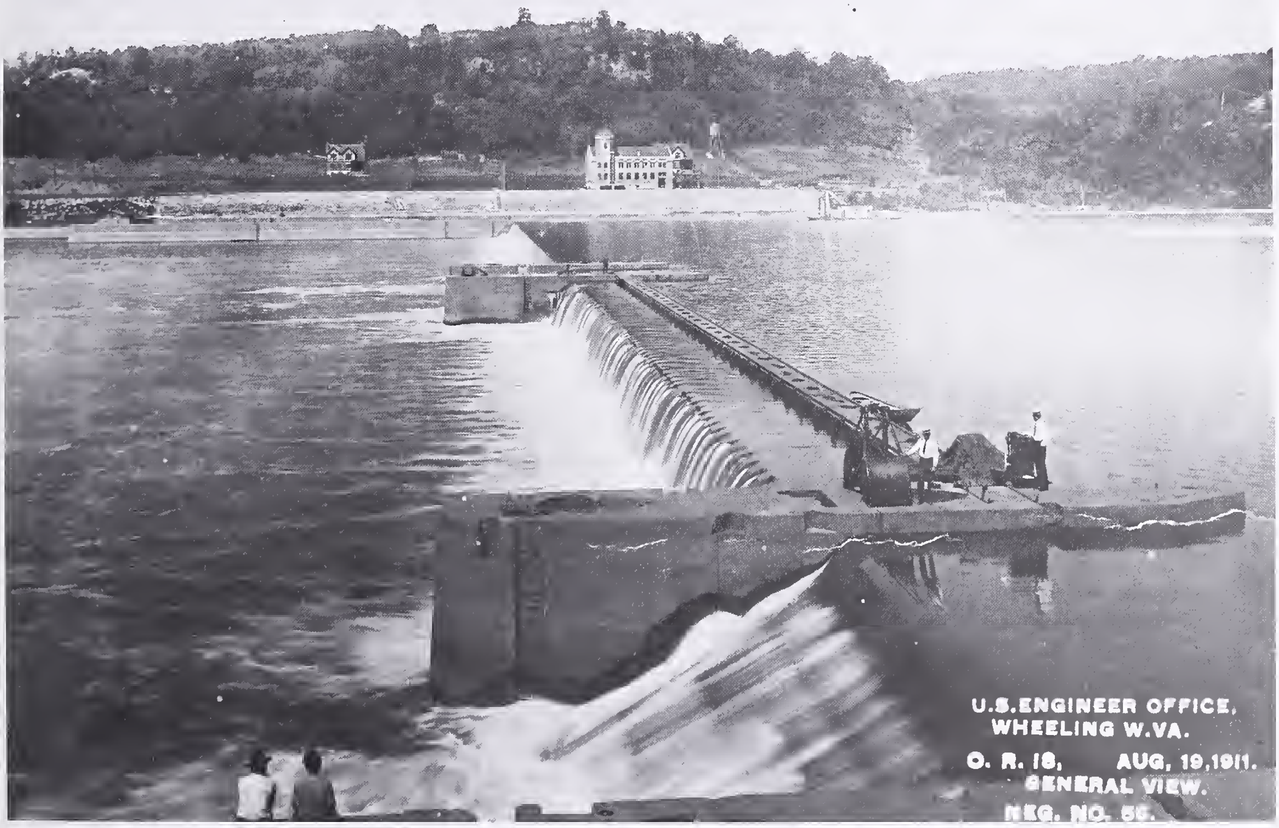
The Huntington Engineer District was formed at the time the big push began to complete the Ohio River canalization program—the slogan was: "On to Cairo by 1929." Thanks largely to the efforts of the Ohio Valley Improvement Association, the locks and dams in the Huntington District and below were built to provide a nine- instead of a six-foot depth for navigation. The OVIA at its Parkersburg convention of 1901 had pointed out that loaded barge-tows on the Ohio always drew more than six feet and urged Congress to approve increasing the pool depths to nine feet. In 1905 Congress ordered a study of this question and of the economic feasibility of extending slackwater down to the mouth of the Ohio.

A special board of engineers, known as the "Lockwood Board," after its senior member, Colonel Daniel W. Lockwood, undertook the study and learned that while the steamboat packet trade was dwindling toward oblivion about nine million tons of bulk commodities, chiefly coal from the Monongahela and the Kanawha, were barged downriver annually. The board estimated that a six-foot project from Pittsburgh to Cairo would cost about $51 million, while a nine-foot depth would require construction of fifty-four dams at about $63 million. The nine-foot project would, however, provide cheaper transportation and be more economical over the life of the project. Though waterborne commerce was declining on the Ohio in 1906, as it was nationally, the board argued a completely slackwatered river would furnish such cheap transportation that a huge traffic would surely develop.

In reviewing the Lockwood Board report, the Board of Engineers for River and Harbors observed that the Ohio River nine-foot project was unprecedented, and was on a scale never before attempted in the United States, but that the Ohio was the "one river of all others most likely to justify such work." The Chief of Engineers cautiously pointed out that the proposed project was based on a conjectural future commerce, and that Congress had never before sanctioned such a huge project on the basis of a predicted, rather than existing, commerce. Instead of recommending the project, he preferred to leave its consideration to the wisdom of Congress.

With the support of the prowaterways administrations of Presidents Theodore Roosevelt and William H. Taft, and with leadership supplied by Congressman Theodore E. Burton of Ohio, Congress acted decisively in 1910, approving construction of all of the fifty-four locks and dams required to provide nine-foot slackwater navigation from Pittsburgh to Cairo and declaring its intention to fund the work at a rate sufficient to reach Cairo in twelve years—by 1922.

The Ohio River project is sheer folly, said John



One of the early locks and dams built during the canalization of the Ohio River.

Typical Ohio River coal tow.

H. Peyton, a nationally known transportation economist. It is a preposterous, astonishing, mad scheme. Railroads, he predicted, will soon drive steamboat packets from the inland rivers; railroads will improve efficiency, undersell all river transportation, and carry the coal and coke shipments that were keeping Ohio River commerce alive. The editor of the influential *Engineering News* also predicted that the investment in Ohio River locks and dams would be lost. But President Taft signed the 1910 appropriations bill, saying: "It seems to me that in the development of our inland waterways it would be wise to begin with this particular project and carry it through as rapidly as may be."

Congress did not keep its pledge to fund the Ohio River project at the rate necessary to reach Cairo by 1922; and in 1917, at American entry into World War I, construction nearly ground to a halt as Ohio River commerce hit bottom. The immense coal barge fleets that had descended the Ohio on every flood since 1854 suddenly stopped running in 1916, when the Monongahela River Consolidated Coal & Coke Company—the "Combine"—terminated river shipments because of increased demand for coal by the upper Ohio valley steel plants, heavy losses experienced in navigation on unimproved river sections, and growing competition of coal delivered by rail and oil piped in from Oklahoma and Texas. At a single stroke, Ohio River tonnage was slashed in half.

Thomas P. Roberts, who had kept in close touch with developments on the Ohio since he surveyed it with his father in 1866 (Ch. V), was discouraged by the abrupt drop in commerce on the river. The Ohio is becoming, he said, merely a "playground for owners of small locally owned boats engaged in a short-distance transportation."

Railroad president Frank H. Alfred said it was clear that funds spent on the Ohio River canalization project had been wasted and that the Corps of Engineers should admit defeat. "The Ohio is the one river in the United States," he said, "on which there seemed to be a fair prospect of developing a large and important traffic. These great expectations have not been realized."

But the "petrified conservatives" of the Corps were not ready to abandon the Ohio River to the fate which had befallen the Guyandotte slackwater project. Huntington District Engineer Malcolm Elliott said the Ohio River project was like a railroad from Pittsburgh to Chicago that had only been completed to Fort Wayne—of little value until open from end to end. Principal Engineer Frederick B. Duis pointed out in 1922 that long-distance shipment of steel and petroleum by river was beginning, and he predicted that commerce would grow gradually until the project was completed, and then skyrocket.

Large Freight Savings Effected

Jones & Laughlin Steel Corporation had sent 4,000 tons of steel products in barges pushed by the steamboat *Transporter* down the Ohio and Mississippi in 1921 and saved a tidy sum thereby. The corporation began regular water shipment and was emulated by Carnegie Steel, American Bridge, Inland Steel, Wheeling Steel, American Steel and Wire, and other companies, which purchased fleets of barges and towboats for river hauls. The companies saved as much as $3 a ton over rail shipment charges in spite of the fact that there were few return cargoes. Gasoline from Sistersville and Parkersburg, West Virginia, and oil from Catlettsburg, Kentucky, began moving by river during the early 1920's, and coal from the Kanawha and from the port of Huntington continued moving by river to Cincinnati and Louis-

A Jones and Laughlin steel tow entering the lock chamber of a low-lift dam.

ville. Some Kanawha coal was even shipped upriver. The new steel and petroleum traffic was encouraging; leaders in these industries lent their support to the Ohio River project, and in 1922 Congress appropriated $42 million to rush construction toward Cairo.

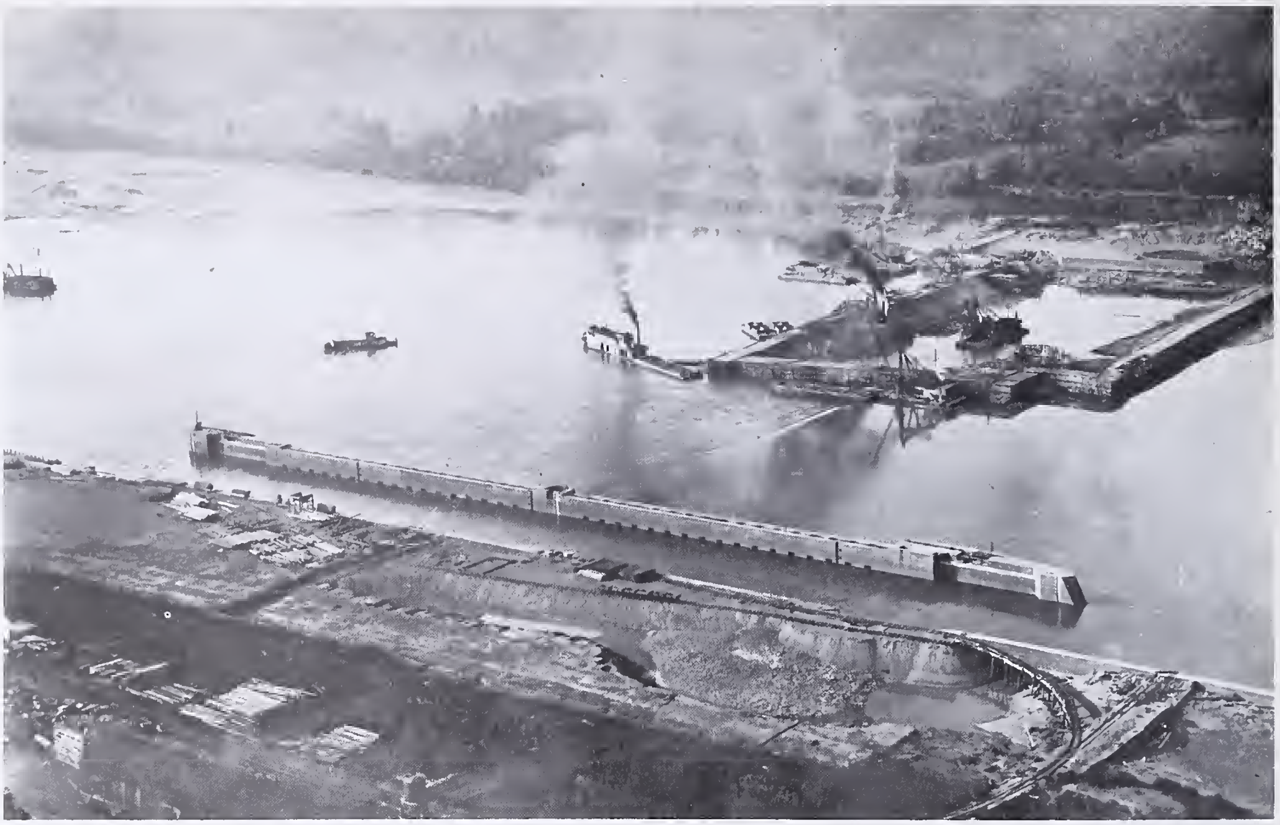
Building the Navigation Structures

The first construction supervised by the Huntington District was rapid completion of the Ohio River locks and dams begun by the Wheeling and Second Cincinnati districts. This work was attended by all of the difficulties incident to construction in riverbeds. Floods arrived at any time of year, overtopping the low timber-crib and wooden pile cofferdams then used, damaging construction equipment, destroying partially finished work, and burying the worksite under tons of mud. Monetary cost records were carefully maintained, but few accounts of the human costs were kept.

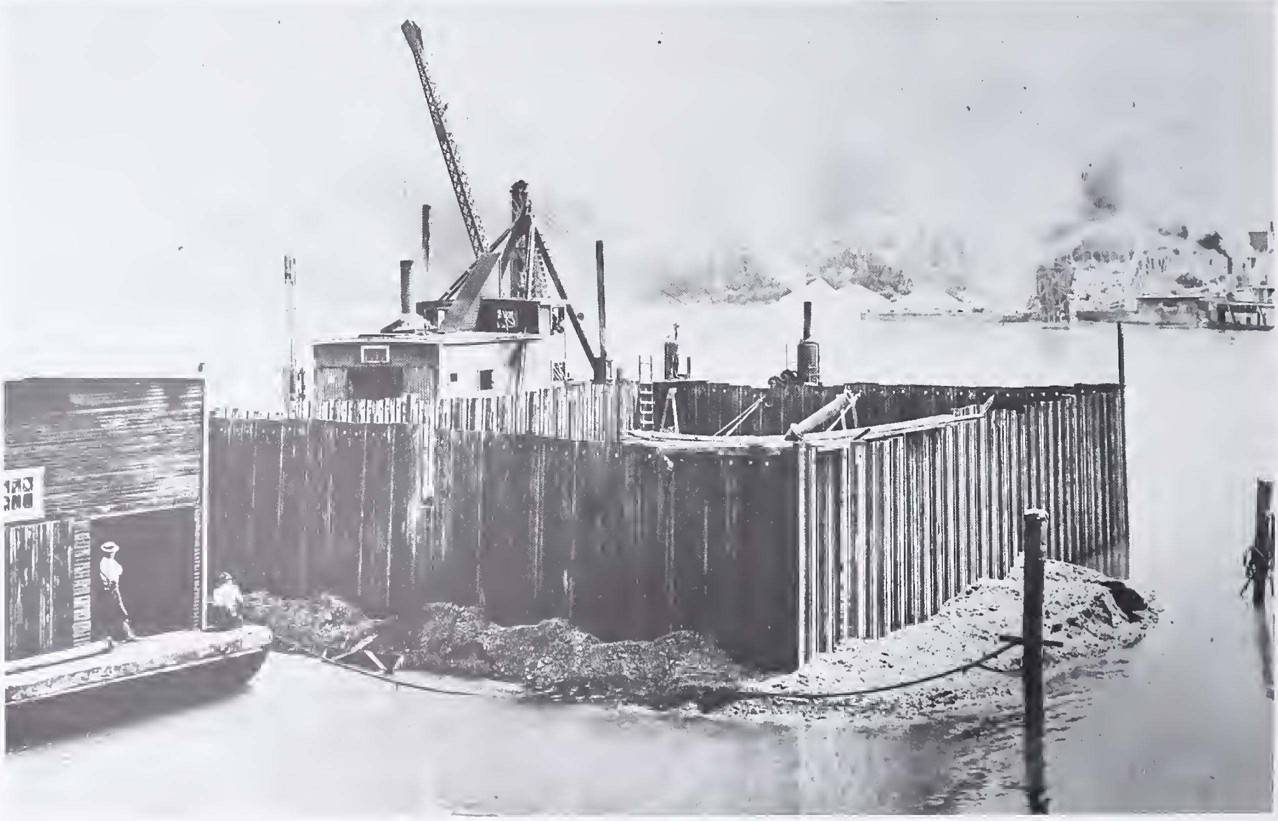
The Engineers built several of the Ohio River locks and dams with Army equipment and hired labor, because contractors had to assume all risks of flood damage to equipment and partly finished work, and only the hardiest, brashest contractors would sign up for work on the flood-prone Ohio.

To keep out the surging river, four, sometimes five, cofferdams were built at each lock and dam—one around the lockpit, one for the dam abutment, one for the navigable pass section, and one around all or part of the Chanoine and beartrap weir sections. Cheap, quickly framed, and easily placed "Ohio River box-type" coffers were commonly used. Boxlike timber frames, 18 feet long, 20 feet wide, and 16 to 20 feet high, were built on scows and barges, dropped into the river on the natural bottom, connected with box sections already in place, sided with rough lumber, and filled with material dredged from the riverbottom. Cofferdams were also built of two rows of overlapping wooden sheet piles about twenty feet apart that were tied together with steel rods for bracing and filled with dredged materials. Neither the box nor the wooden pile types were impermeable, leakage was expected, and powerful centrifugal steam pumps ran day and night to keep the worksite inside the coffer reasonably dry.

Cellular steel sheetpiling cofferdams were first developed by the Corps of Engineers in 1911 to permit recovery of the wreck of the battleship *Maine* from the floor of Havana harbor; and this



Timber crib piling was used for coffers on the earlier locks and dams built by Wheeling and later in the Huntington District.



Cellular steel sheet piling, developed by the Corps of Engineers in 1911, was first used on the Ohio project at Locks and Dams 23, 25, and 34.

type coffer was first used on the Ohio River at Locks and Dams 23, 25, and 34. Cellular steel coffers reduced seepage and permitted a longer working season, but they were not much used on the Ohio River because it was thought their cost outweighed their advantages.

After cofferdams were in place and clear of water, men went down into the "hole" with small steam shovels, traveling derricks, locomotive cranes, and the old reliable shovels and wheelbarrows to remove the mud and loose rock (overburden) from atop the foundation rock.

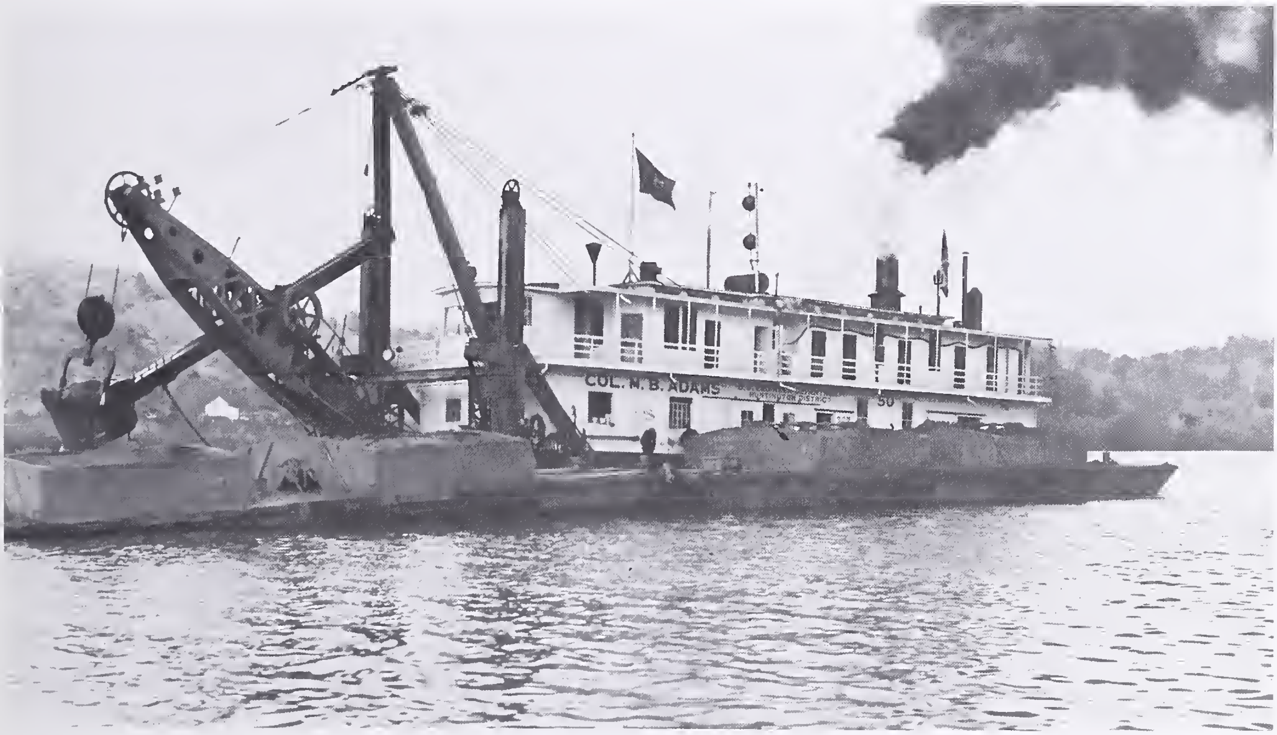
A rock foundation was generally located at accessible depths at locks and dams above No. 31, but downriver from 31 the locks and dams ordinarily rested on thirty- to forty-foot-long wooden piles driven to rock, with a row of interlocking wooden and steel sheet piles along the upstream face of the structure to reduce seepage and prevent undermining. Only a single dam on the Ohio failed because of foundation problems, and that was No. 26, below Gallipolis, where the foundation shale slipped downstream under water pressure and the navigable pass had to be rebuilt.

Once the foundation was exposed, carpenters built forms for the lockwalls and dam and the pouring of concrete began. Sand and gravel aggregate was dredged from the riverbed and moved in barges to concrete mixing plants inside the coffer or along its rim, or sometimes on barges. Concrete was moved from the mixers to the forms in different ways: in some locations, buckets of concrete were swung from the mixers to the forms by overhead cableways—"highlines"—stretched across the river between high towers; at other places, mixer plants traveled on rail tracks and concrete was poured directly from the mixer into the forms through long chutes; and at other sites concrete buckets were hauled on flatcars along rails by dinky locomotives.

After concrete was poured and had set, the wickets and other appliances were bolted in place, the construction equipment was moved into the next cofferdam, and the old coffer was torn out.

Thus, inside a series of cofferdams in a line across the river, the lock and dam was built in sections. The dams were most difficult to build and were very large structures, but they were less impressive than the locks because they were largely submerged after the cofferdams were removed.

Each Ohio River lock and dam differed in some respects from all others, but the typical structure had the standard 110-foot by 600-foot lock



"Colonel N. B. Adams," a dipper dredge, was used in the construction of the coffers for the locks and dam.

chamber with concrete land- and riverwalls. The first locks built had expensive stone-masonry walls, but after 1900 masonry was replaced with concrete.

Next to the lock was a navigable pass section from 600 to 1,200 feet long, according to riverwidth, closed by movable Chanoine wickets. Next were three piers between which two 91-foot long beartrap weirs were installed. And next to the beartraps was a long Chanoine weir section to close the river from the beartraps to the dam abutment on the bank opposite the lock.

Locks built before 1914 had Merrill rolling gates housed in recesses in the lock landwall. The Merrill gates worked well on the upper river, where the riverbed consisted chiefly of coarse gravel and floods were of shorter duration, but below Huntington the Merrill gate recesses filled with sand and mud from the soft, shifting banks after every flood. For this reason, the Merrill gates were replaced in locks begun after 1914 with structural-steel swinging mitering gates. These were on a design developed by Malcolm Elliott. Merrill gates rolled on tracks across the lock chamber pulled by wire ropes winding on drums; mitering gates were opened and closed with a single stroke by pistons in hydraulic oil cylinders.

The finishing touch at each lock and dam was the operations building and the neat frame, brick, and terra cotta homes adjacent to the lock, built for the use of the lockmaster and his chief assistant and their families. The lockmaster and his assistant were on twenty-four hour call; other operating employees lived nearby and commuted. Gardening was permitted, and great care was lavished on maintaining sturdy fences, well-tended buildings, and closely clipped grass at the lock reservations. The reservations were a pleasant place to spend a lazy summer afternoon, and the first funds spent for public recreation in the Huntington District were invested in picnic tables and basic facilities at the lock reservations.

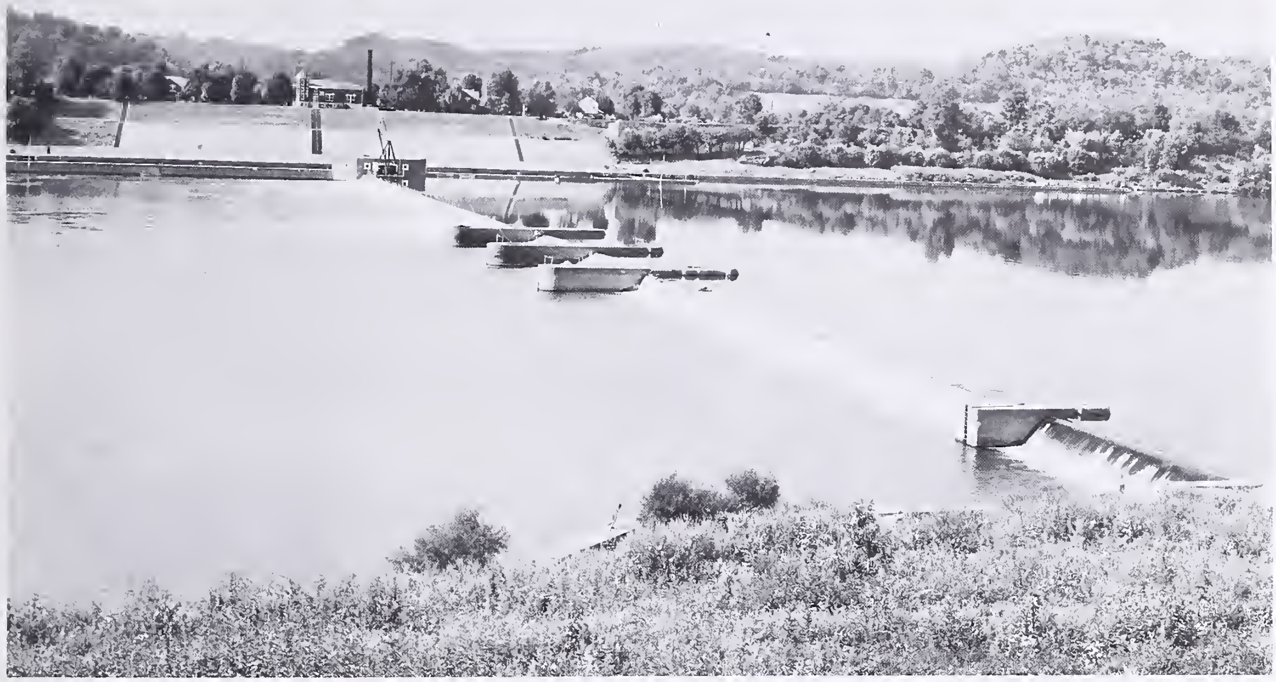
Ohio System Completed in 1929

The Ohio River locks and dams in the Huntington District were open to navigation by the end of 1926, and that year, with slackwater available to Cincinnati, two modern rail-river terminals were completed at Huntington for transshipment to barges of four million tons of Guyandotte valley coal annually destined for Cincinnati.

Construction was pushed at an astonishing rate in the downriver Cincinnati and Louisville Engineer districts; and in 1929 the Corps achieved

U.S. ENGINEER DEPARTMENT HUNTINGTON DISTRICT

A Corps of Engineers quarter boat used to house Corps employees during the construction of locks and dam.



One of chanoine wicket type dams that composed the Ohio River system completed in 1929.

its goal, the opening of nine-foot slackwater navigation on the Ohio from head to mouth, from Pittsburgh to Cairo.

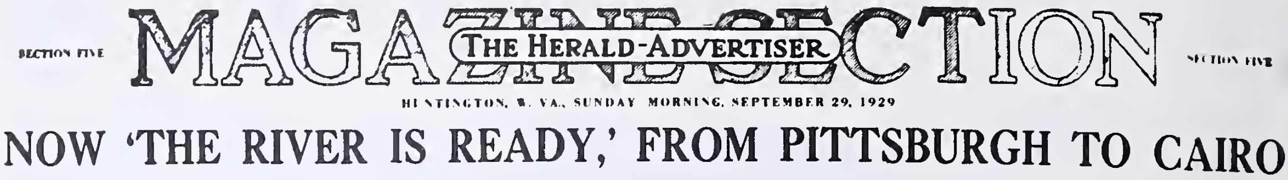
At a cost of $125 million, about a third the cost of the Panama Canal, the Ohio River canalization project was completed very much along the lines laid out by Colonel Merrill in 1875. Merrill had planned fifty-four locks and dams. By changes in location and increased lifts, the number was reduced to fifty. And by 1938 the number was further reduced to forty-six by construction of high-lift structures such as the Gallipolis Locks and Dam.

To celebrate project completion, the Ohio Valley Improvement Association staged a magnificent steamboat packet pageant, reminiscent of the Davis Island celebration of 1885, except that the packets traveled the entire length of the river. The flagship *Cincinnati*, followed by the *Greater Pittsburgh* and the *Queen City*, left Pittsburgh on October 19, 1929, to begin the dedication parade. The pilots on the flagship were Captain James H. Rowley, who had participated in the Davis Island celebration of 1885, and Captain Jesse P. Hughes, who had piloted a boat at the opening ceremonies for the second lock and dam completed—Merrill Dam (No. 6)—in 1904.

All along *La Belle Riviére* sirens wailed, whistles screamed, bells tolled, and cannon blasted welcomes as the line of steamboats passed downriver. Baskets were lowered to the boats with flowers and greetings as the flotilla steamed under the bridge at Parkersburg. The packet *Tom Greene* joined the parade at Point Pleasant. And at Huntington a huge electric sign flashed welcome, a band played "West Virginia Hills," and the Governor of West Virginia and the Huntington District Engineer boarded to join the party. There was one grim reminder of the Davis Island celebration when a salute cannon fired prematurely and killed a gunner, but on the whole it was a safe and exciting trip, a sort of last fling for the steamboat packets, whose last remaining business was soon to be killed by the Depression. Ironically, it was the barge-towing interests, who had fought Colonel Merrill and the Ohio River project at the beginning, who were to reap the greatest benefits from the nine-foot channel.

President Herbert Hoover joined the packet parade at Cincinnati and spoke to the immense crowds gathered at riverports along the route. The President expressed his regret that Colonel William E. Merrill had not lived to join in the celebration, and he concluded one speech with an especially perceptive summary of the place of the Ohio River project in history:

> While I am proud to be the President who

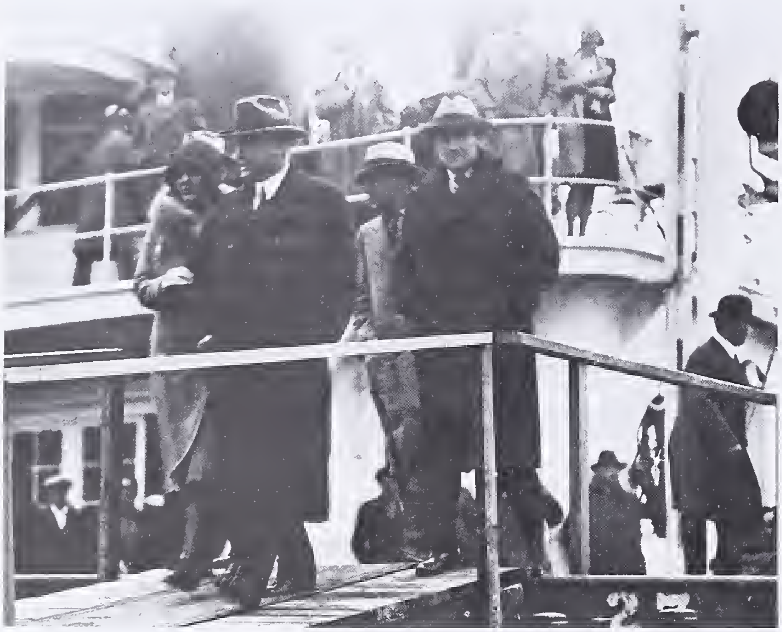


SECTION FIVE MAGAZINE SECTION THE HERALD-ADVERTISER SECTION FIVE

HUNTINGTON, W. VA., SUNDAY MORNING, SEPTEMBER 29, 1929

NOW 'THE RIVER IS READY,' FROM PITTSBURGH TO CAIRO

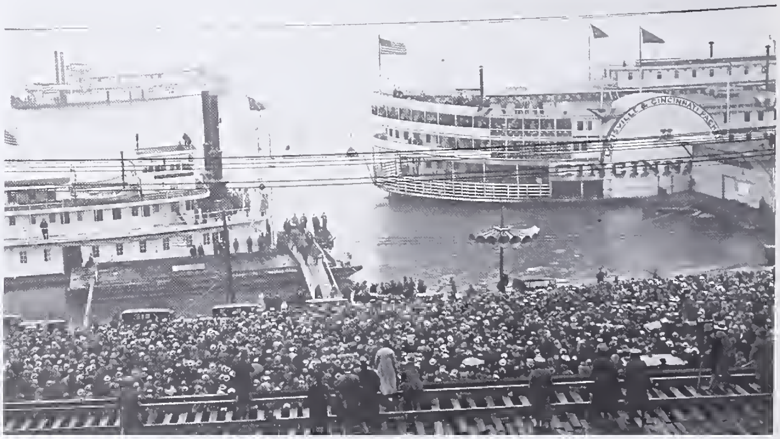
Huntington newspaper headline, September 1929.



Herbert Hoover at Louisville during celebration of the completion of the first Locks and Dam system on the Ohio River in October 1929.

—Canfield and Shook, Inc. Photos

Another view of the river festivities in Louisville during the celebration October 1929.

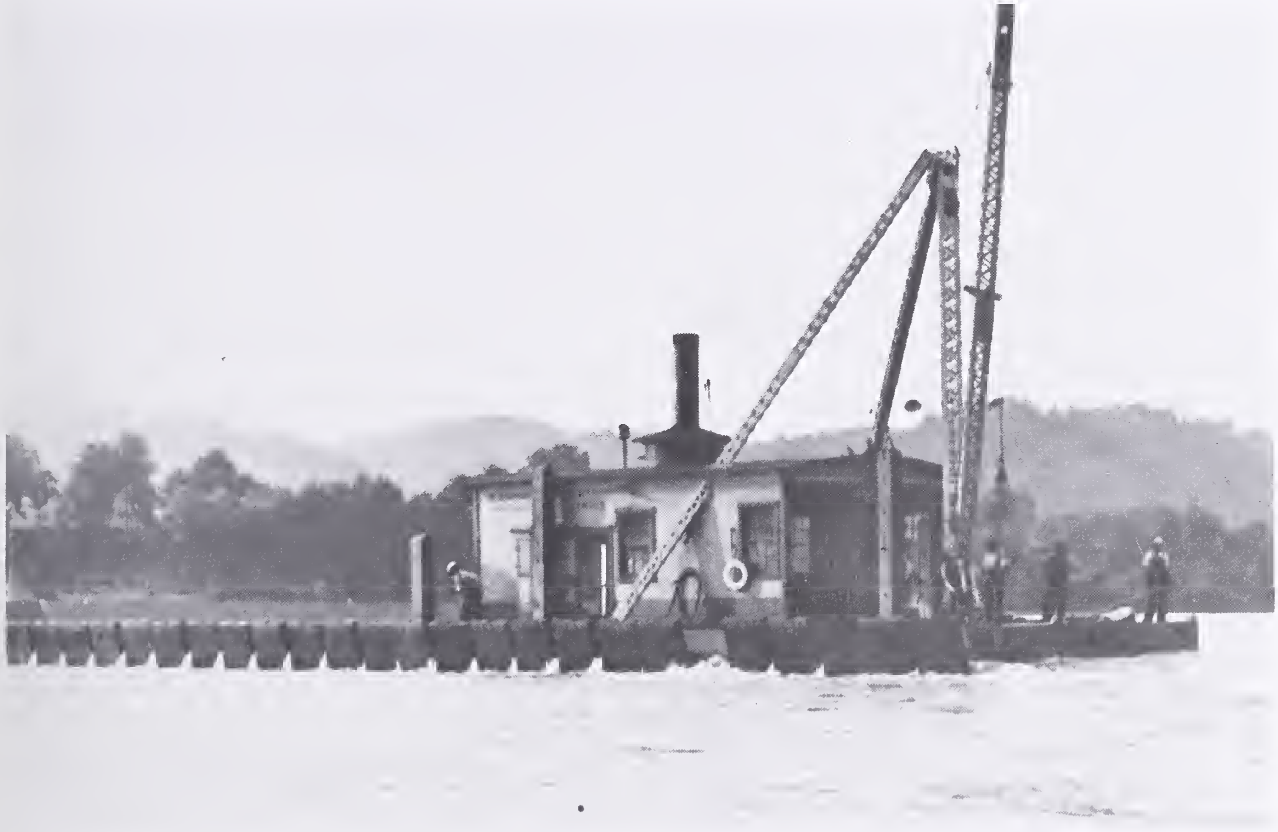


witnesses the apparent completion of its improvement, I have the belief that some day new inventions and new pressures of population will require its further development. In some generations to come, they will perhaps look back at our triumph in building a channel nine feet in depth in the same way that we look at the triumph of our forefathers when, having cleared snags and bars, they announced that a boat drawing two feet of water could pass safely from Pittsburgh to New Orleans. Yet for their times and means they, too, accomplished a great task. It is the river that is permanent; it is one of God's gifts to man, and with each succeeding generation we will advance in our appreciation and our use of it. And with each generation it will grow in the history and tradition of our Nation.

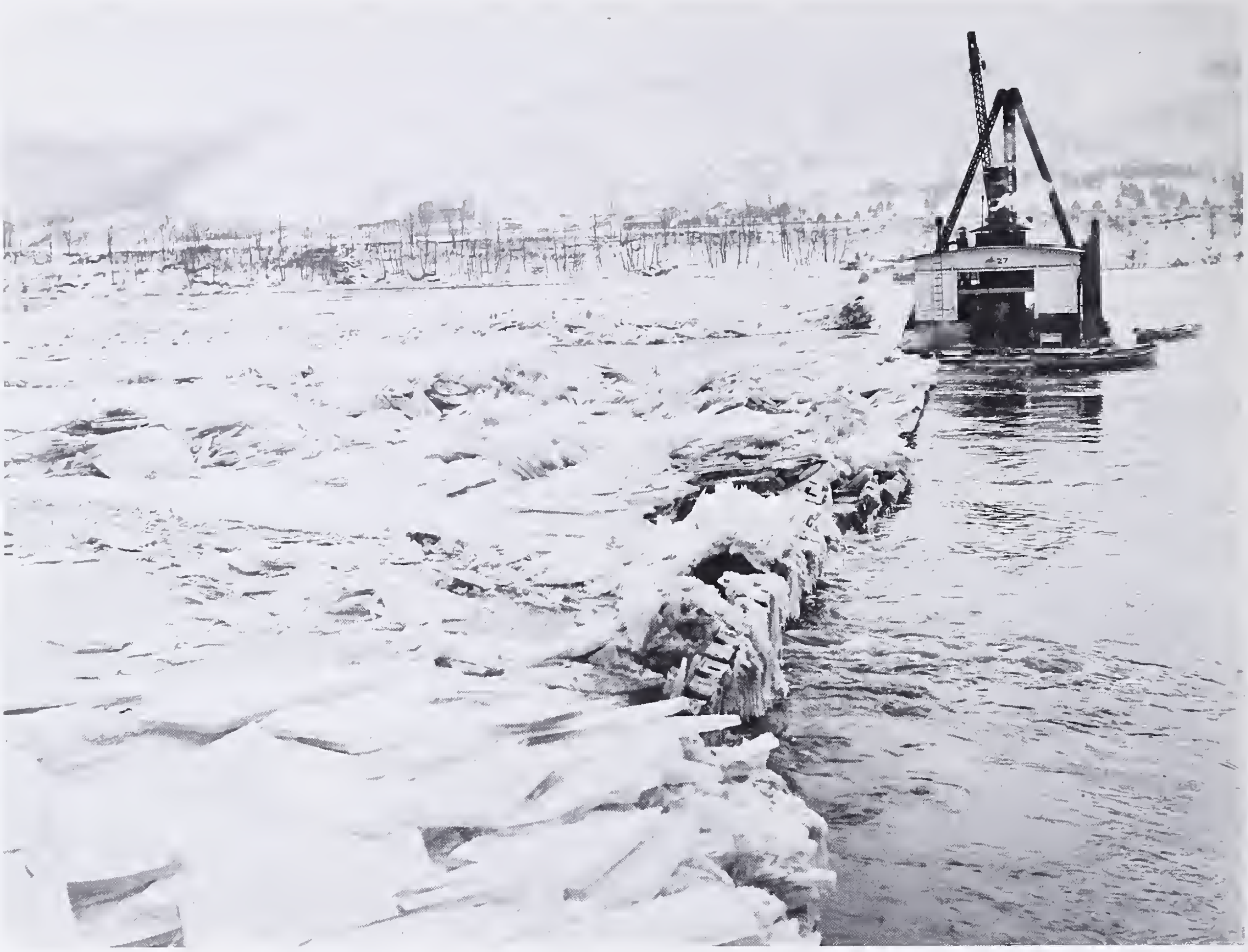
The editor of *Engineering News-Record* reminded his readers in 1929 that completion of the Ohio River project had long been awaited by both friends and foes of inland waterways because they believed the operation of the project would furnish conclusive evidence of the possibilities of waterway commerce. Future waterway development hinged on the success or failure of the Ohio River project as a transportation artery.

Working of Locks and Dams

The key to the growth of river commerce after 1929 was operation of the locks and dams. The operation of the dams appeared simple in theory. At low water stages the wickets were raised in a row across the channel to hold a navigable pool. Small rises were passed through the beartraps, which could be raised or lowered by two men, and at floodtime a specially designed maneuverboat, equipped with hoisting engine, winches, and capstan, went out along the upstream side of the wickets, and its crewmen lowered each wicket in turn until the dam was all down. Traffic went through the navigable pass until the river began to fall; then the maneuverboat went out again, the crewmen grappled for the handles on each wicket and raised them one by one until the dam was standing and holding a pool. A good crew in clear weather could lower the wickets of the navigable pass in two hours or raise them in six. But conditions were seldom optimum.



A Corps of Engineer Maneuverboat raising wickets on one of the dams.



The most dreaded danger to dam operation was ice, which prevented access to the upstream side of dam for maneuver activity.

In practice it was learned that riverflow fluctuations, particularly as a result of floods on tributary streams, were often so swift that the dams could not be raised or lowered fast enough to maintain proper pool levels. Because maneuvers at one lock and dam affected river stages above and below it, operations at all dams had to be coordinated by telephone and radio, and changes in riverflow, rainfall, and weather conditions had to be anticipated.

A near record drought in 1930 tested the project in its first full year of operation. By placing pieces of wood—"needles"—between the wickets, closing the gaps, and by dropping cinders, straw, and similar materials into the river just above the dams to seal spaces between needles and wickets, the pools were maintained and navigation continued. As Colonel Merrill had predicted in 1885, the ancient slur that the Ohio River was dry half the year was soon forgotten.

Drift and ice presented more serious problems than drought to successful operation of the movable dams. As much as ten acres of drift accumulated above the dams at times, blocking approaches to locks and preventing access to the upstream side of the dams for maneuver activity.

The most fearsome danger to operation was ice, which coated wickets, equipment, maneuverboat decks, and all else with a slippery surface. In February 1934, for example, coal was desperately needed at Cincinnati and it was vital that the navigation pools be maintained for coal barges moving downriver from Huntington. Ice formed on the night of February 8, but the forecast was for a low temperature of 15 degrees and the wicket dams were left up. During the night the temperature plummeted to a bone-chilling 5 degrees below zero and the wickets had to be dropped the next morning to prevent destruction by icefloes. Some dams were lowered by butting the wicket props free with steamboats below the dams, with the hazard that lowering the wickets would loose the icepack to crash down on the boats. At one dam an attempt to lower the wickets from above with a maneuverboat was made and the boat was swept over the dam. Had the boat capsized, every crewman would have drowned in the icy Ohio, but luck was with the

Engineers. They were not always so fortunate.

A thaw began on February 11, the river swiftly dropped, and for the first time since the project was completed in 1929 the nine-foot slackwater pools were lost. Coalfleets from Huntington were still in the pools and the Engineers again braved the ice to raise the dams. The pools were restored, but pack ice again built up above the wickets, threatening to destroy the dams. On the night of February 25, in a driving blizzard, the lock and dam forces of the Huntington and Cincinnati districts had again to return to the river and butt the dams down from below.

Decentralizing District Operations

The District Engineer, Major Fred W. Herman, reorganized Huntington District operations in 1931 to permit closer supervision by establishing Engineer suboffices with responsibility for areas that could be covered in an automobile in a single day. The Marietta Suboffice at the Repair Station, directed by Associate Engineer J.Y. Neuhard and Overseer J.E. Carpenter, was made responsible for the operation of locks and dams on the Muskingum and the Little Kanawha, and Nos. 14 to 20 on the Ohio. The Catlettsburg Suboffice, directed by Associate Engineer Carlton Allen, Inspector Rowland R. Castle, and Overseer Forester "Pop" Farley, supervised the Big Sandy locks and dams and Nos. 21-28 on the Ohio. A third suboffice at Charleston, directed by Captain Lewis A. Murray, Senior Engineer Harry Pockras, and Associate Engineer Frank Conklin, was made responsible for operation of the Kanawha River locks and dams, as well as immediate supervision of the navigation modernization program in progress on the Kanawha in 1931.

Uptrend in Ohio Commerce

Waterborne commerce on the Ohio totaled 22.5 million tons in 1930, dipped slightly in 1931 and 1932 due to the economic depression, and increased each year thereafter, soaring to 36.5 million tons in 1941. The average distance commodities were shipped on the Ohio was 55.6 miles in 1926, 66 miles in 1930, and 142 miles in 1941. Petroleum and iron and steel shipments increased both in volume and in percentage of total commerce. By 1941 petroleum and petroleum products were second in tonnage only to coal.

By the onset of World War II it was clear the Ohio River nine-foot project was an unqualified success, stimulating new traffic and greater total tonnage, contributing to the economic and industrial growth of the region, and far exceeding the predictions of the Lockwood Board which recommended the nine-foot project in 1909 on the basis of "conjectural future commerce."

Agitation for Upgrading Kanawha

The nine-foot project on the Ohio generated a demand for the improvement of tributary streams to the same nine-foot depth. The Kanawha River, with small locks and a six-foot depth, for example, was described as like a narrow-gage railroad connected with a standard-gage.

Kanawha River coal tows were "double locking" as early as 1901. A towboat pushing six barges made up the typical Kanawha tow. At each lock four barges were pushed into the chamber, detached from the rest of the tow, locked down, and floated out of the lock by a current created by opening valves in the upper lock gate. The towboat and the last two barges followed through the lock, rehooked to the first four barges, and proceeded to the next lock to repeat the process. Double lockage required at least thirty minutes at each lock on the Kanawha, and by 1926 triple lockage was not uncommon.

Kanawha coal shipments had averaged just over a million tons annually for thirty years after the six-foot channel project was completed in 1898. Total tonnage had not increased because of the limitations of the project and the competition of Guyandotte rail coal transshipped at Huntington. Coal shipments from Huntington quadrupled between 1921 and 1927, but there was no appreciable increase in shipments from the Kanawha during the same period. It was a curious anomaly: prior to 1926 the Kanawha River coal trade was hampered by the only partially improved Ohio; after 1926 Kanawha coal shipments were hindered because barges loaded for the full nine-foot Ohio River depth could not navigate the Kanawha.

Changing Kanawha Commerce

The character of commerce on the Kanawha was changing during the 1920's. The heavy trade in timber and forest products had disappeared by 1920; steamboat packets, which had carried as much as 100,000 tons a year at peak, were disappearing—the *Liberty*, the last commercially operated steam packet on the Kanawha, went downriver, pushing its wharfboat before it, in 1936. On the other hand, barge transportation of petroleum products, serving the Pure Oil Company's Cabin Creek refinery and Standard Oil Company's bulk terminal at Pratt, began on the Kanawha in 1922 and climbed to 100,000 tons in 1931; and water carriage of raw materials and chemicals for the growing Kanawha valley chemical industry were also beginning.

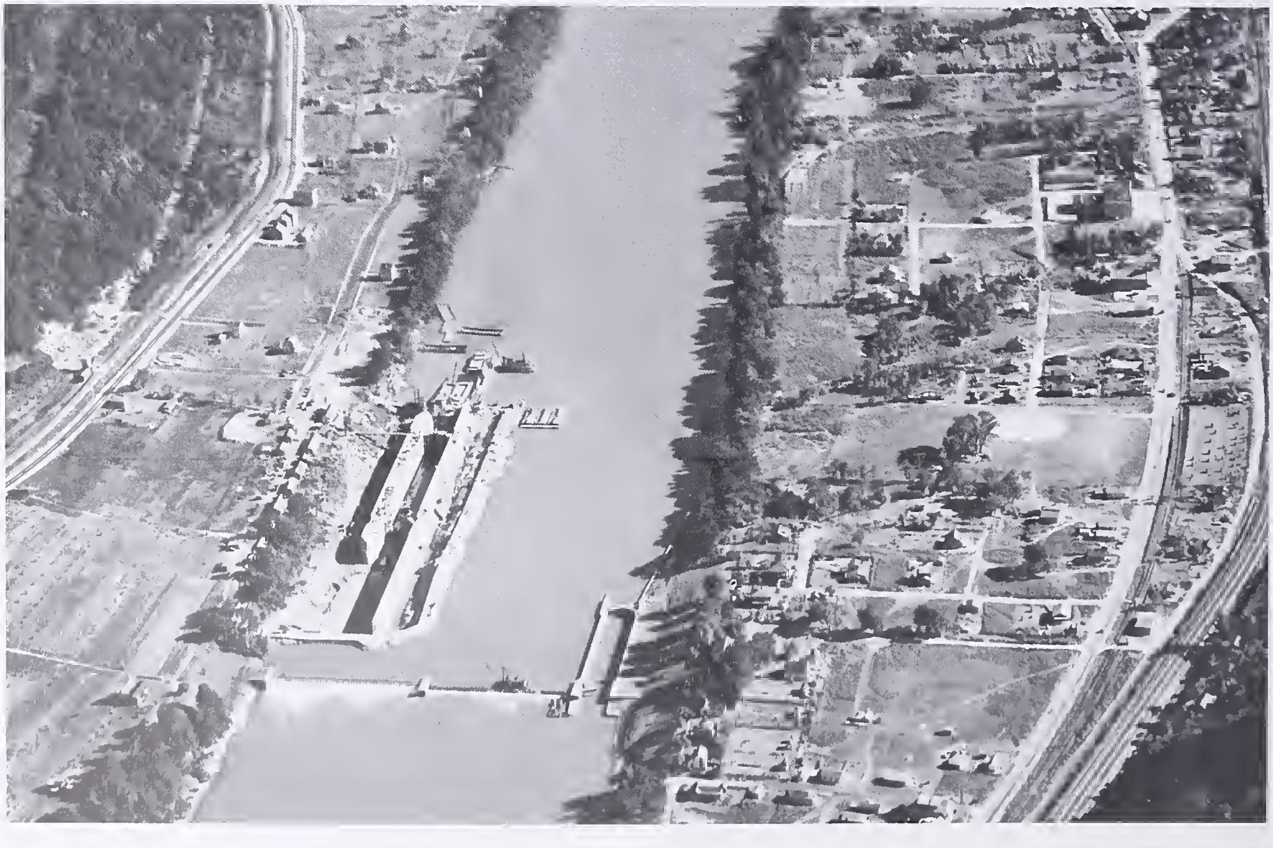
Prior to the First World War, many chemicals were imported from Germany, but in 1914 war severed this source of supply and plants were built in the Kanawha valley to produce chlorine gas and a wide variety of basic chemicals, utilizing gas, coal, and the famed Kanawha salt brine. When the United States entered the war in 1917, the government launched a search for inland industrial locations, secure from threat of enemy attack, and the Secretary of War visited Charleston, where he was met by Addison Scott and Charleston civic leaders who convinced the Secretary and his technical staff that the Kanawha valley would be an excellent location for war-related industrial production. The Navy Department built a huge armor plate plant in South Charleston and the War Department a tremendous explosives plant at Nitro, both completed as the war ended, but never brought into use. After the war, Union Carbide and Carbon Corporation, the du Pont company, and other companies built chemical plants at Belle, South Charleston, Institute, and Nitro.

Both the government and the chemical companies located in the Kanawha valley because of the proximity of fuel and raw materials, the reliable water supply, favoring conditions with respect to labor, excellent rail transportation, and the economical water transportation furnished by the Kanawha River project.

Modernizing the Kanawha Waterway

When the Huntington Engineer District was established in 1922, the first full-scale river survey assigned to it was an examination of the Kanawha River from Lock 5 (at Marmet) upriver; and District Engineer Harry M. Trippe reported that Locks and Dams 5 to 2, all about forty years old, badly needed major repairs. He suggested it might be wiser to put money into new structures, and recommended the building of two new high dams to provide a nine-foot channel depth, with twin 360- by 56-foot locks at each dam. The Board of Engineers for Rivers and Harbors and the Chief of Engineers agreed that building two new dams with larger twin locks would be better than pumping money into the repair of the four old structures, but they did not see the necessity for building to achieve a nine-foot channel. After all, they said, the lower Kanawha had only a six-foot depth; this comment was much like waving a red flag before a bull.

Kanawha valley coal, industrial, and navigation interests, led by Ernest M. Merrill of the Great Kanawha Barge Line, George E. Sutherland of West Virginia Sand and Gravel Company,



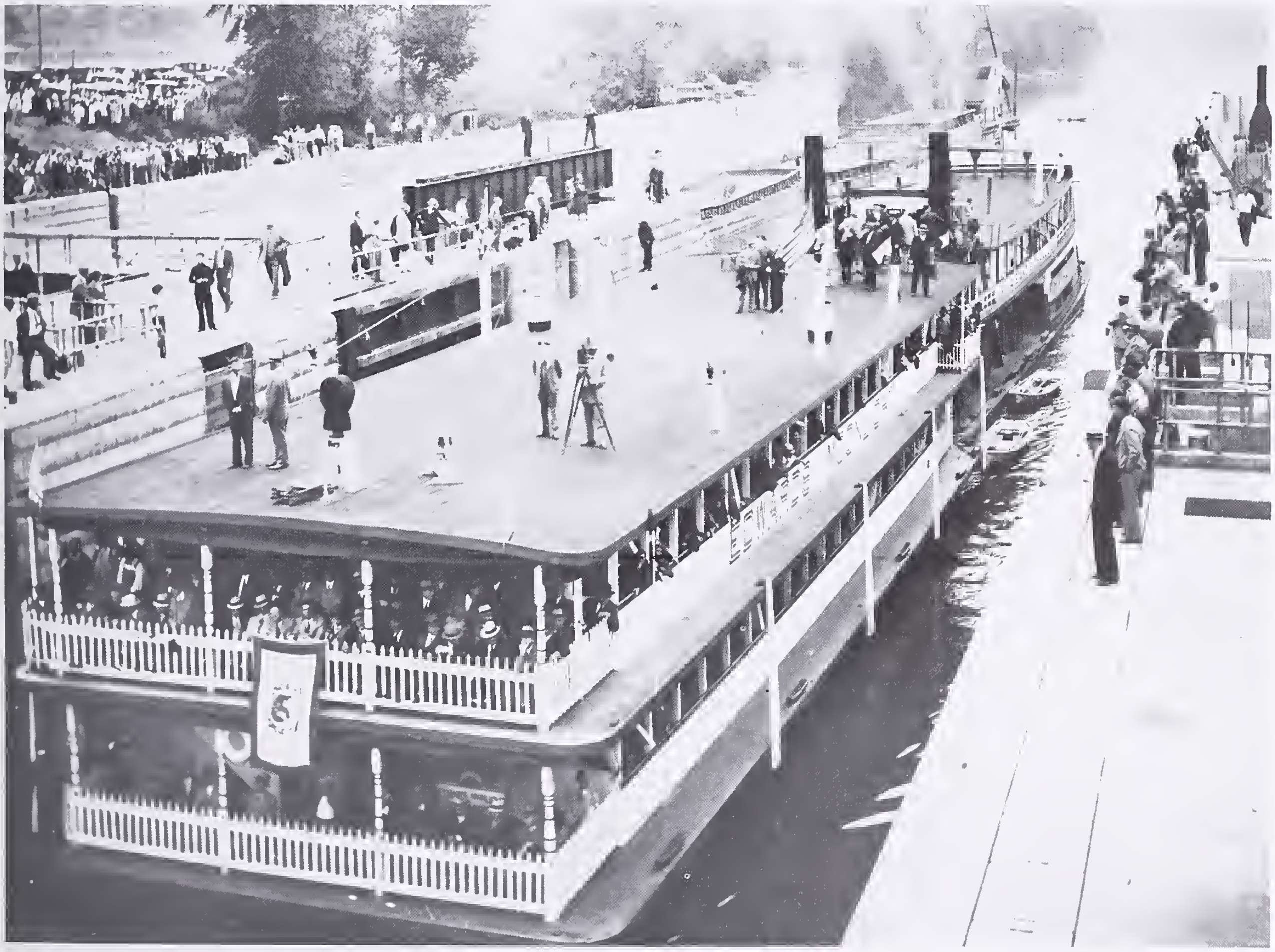
Marmet Locks and Dam under construction in the early 1930's, with old Lock and Dam No. 5 still in operation on the Kanawha River.

S.P. Puffer of the Charleston Chamber of Commerce, C.C. Bowyer, J.T. Hatfield, and others, quickly organized the Kanawha Valley Improvement Association in 1926 and went to Washington to confront the Chief of Engineers and members of Congress personally on behalf of a nine-foot standard depth for the entire Kanawha. In 1927, Congress approved a study of the modernization of the lower Kanawha, Lock 5 to the mouth, and in 1930 approved a nine-foot project for the upper river, requiring construction of two high dams with movable crests and twin locks, at Marmet and London.

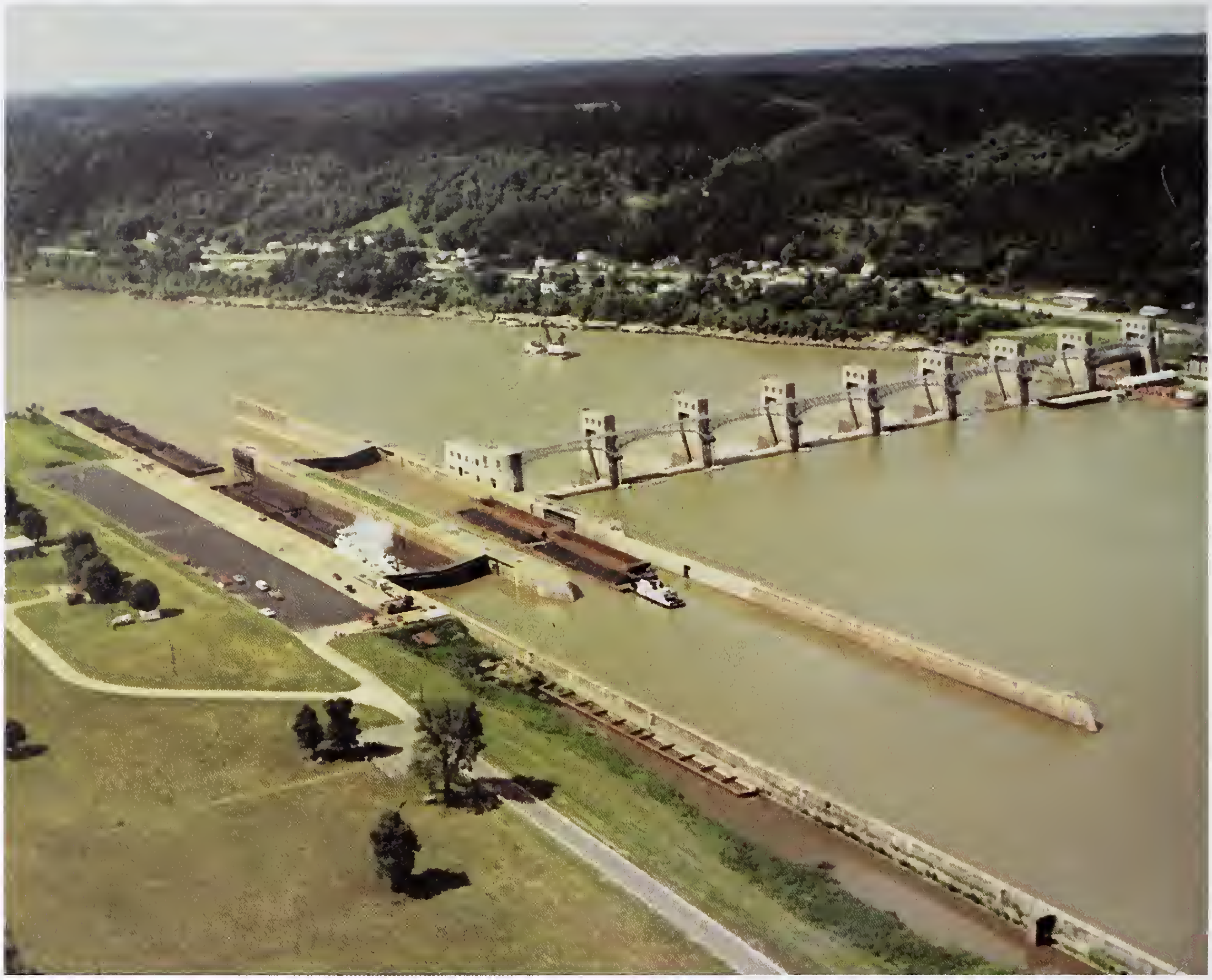
Chanoine wicket dams could not be built to a height sufficient for the dams planned at Marmet and London, and fixed dams of great height could cause flowage damages, so the Huntington District selected nonnavigable roller-gate dams (not to be confused with Merrill rolling lock gates). The roller-gate dam was invented in Germany in 1902, and by 1930 about 160 roller-gate dams had been built in Germany and Scandinavia, but the type had not been favored in the United States.

The rugged roller gates were formed by large steel cylinders, or drums, and a projecting apron, installed between piers over a fixed sill. Hoisting engines atop the piers wound or unwound a chain to open or close the dam by rolling the steel drums up and down between the piers. When down against the foundation sill, the steel drums closed the river and formed a navigable pool; at floodtimes the cylinders were rolled up the piers and held above the river to allow the floodwaters to pass beneath.

Dravo Corporation of Pittsburgh held American rights to the roller-gate dam type patented by the Krupp Corporation of Germany, and Dravo was awarded the contract for construction of roller dams at Marmet and London, 67.8 and 82.8 miles respectively above the mouth of the Kanawha, and for the building of one of the twin locks at each location. Contracts for the second locks at Marmet and London went to General Contracting Company and John Walsh Company. These companies began construction of the Marmet and London locks and dams in the spring of



Marmet Locks and Dam dedication in 1933 with a steamboat parade in honor of Vice President Charles Curtis.



Gallipolis Locks and Dam, dedicated in June 1938, the largest roller dam in the world and the first high lift dam on the Ohio.

1931.

In the meantime, the Huntington District staff completed its study of the nine-foot project from Marmet to the Ohio River. One plan called for replacement of old Locks and Dams 6 through 11 with two high roller dams like those being built at Marmet and London, but the lock and dam in the Ohio River below the mouth of the Kanawha provided only a six-foot depth up to the foot of Kanawha Lock 11 and foundation conditions near the mouth of the Kanawha made high dams difficult of construction. The Kanawha and Ohio projects had been linked together in the original planning studies of Colonel Merrill and General Craighill in 1875, and Lock and Dam 12 on the Kanawha had been eliminated by coordinating the improvement of the two rivers.

The Huntington District Engineer recommended in 1932 that coordination between the Ohio and Kanawha projects be continued by building a high roller dam with twin locks at Winfield on the Kanawha, 31.1 miles above Point Pleasant, and building a huge roller dam with two locks, one 360 by 110 feet and the other 600 by 110 feet, on the Ohio near Hogsett, W. Va., 13.5 miles below the mouth of the Kanawha. Gallipolis Locks and Dam on the Ohio at Hogsett would furnish nine-foot slackwater up to Winfield on the Kanawha and also eliminate old Locks and Dams 24, 25, and 26 on the Ohio, thereby reducing maintenance and operating costs, and likewise saving commercial navigation substantial sums by eliminating the time lost in passing through the three old locks. Construction of the Winfield and Gallipolis Locks and Dams was approved by Congress in 1933.

Because of limitations of "pork barrel" appropriations, many early waterway projects were delayed for unconscionable periods, but the Kanawha modernization project of the 1930's was adequately funded and construction was remarkably swift. Marmet and London Locks and Dams, under supervision of Principal Engineer Harry Pockras and the staff at the Charleston Suboffice, were completed in three years. But the work was not accomplished without incident. Floods delayed construction at least seven times in one year, and the project was marred by a tragic accident at Marmet, where Dravo Corporation was building Lock B. Two men were down in the lockpit working with jackhammers in April 1932 when earth on the side of the lockpit excavation, softened by groundwater, slid into the lockpit and covered them. Twenty-five men rushed down into the hole to dig for the victims and were caught by a second slide rumbling into the pit. Four members of the rescue team were killed and seven others injured.

Tragedies like that at Marmet in 1932 were not common, but accident frequency was routinely high throughout the construction industry before 1933. Construction contractors often recorded 150 injuries per million man-hours worked, and government construction projects commonly had 30 injuries per million man-hours. The Corps of Engineers Safety Program began on July 1, 1933, at a time when similar programs were beginning across the nation. An accident frequency of six injuries per million man-hours on construction work was considered only a fair record by 1941, and in that year, as compared with 1933, the Chief of Engineers estimated the safety program had saved 194 lives and millions of dollars.

Six months after the accident at Lock B, Marmet Locks and Dam was dedicated with a steamboat parade from Charleston to Marmet in honor of Vice President Charles Curtis, who was visiting the area. Marmet was actually completed on May 7, 1934, and the London Locks and Dam on June 25, 1934.

Contracts for construction of the Winfield and Gallipolis Locks and Dams were awarded in late 1933, and with accelerated funding provided by the Public Works Administration (PWA), one of the Depression work-relief agencies, Winfield Locks and Dam was finished in 1937 and dedication ceremonies and another steamboat pageant were held at Gallipolis on June 12, 1938. The nine-foot modernization of the Kanawha was thus completed in less than eight years.

The old Kanawha dams did not have enough fall, or "head," to permit economical electric

JOHN T. WILSON
ASHLAND, KY.
J. C. RAWN

Ceremonies and a steamboat pageant were held in Gallipolis on June 12, 1938, to dedicate the Gallipolis Locks and Dam.

power generation, but Winfield, Marmet, and London dams had lifts of from twenty-four to twenty-eight feet, and the Kanawha Valley Power Company, under license from the Federal Power Commission, installed hydroelectric plants at each dam, paying a set yearly fee for the privilege and furnishing power for operating the locks and dams without cost to the United States. Graham Claytor, vice president of a parent affiliated company said in 1949 the cooperative arrangement had been very satisfactory "from the standpoint of both the Government and our company."

Gallipolis Locks and Dam, the largest of the four modernization structures, was the largest roller dam in the world, with eight giant cylindrical gates, each weighing 730,000 pounds. In four years' construction, 719,000 cubic yards of earth and 62,000 cubic yards of solid rock were excavated, 351,000 cubic yards of concrete were poured, and 12.5 million pounds of reinforcing steel, 668,000 pounds of steel and iron castings, and 910,000 pounds of other metal were placed in the dam. Dravo Corporation built the locks and dam; Beltzhoover Electric built the operations building.

Effects of Nine-Foot Operating Depth

The effects of the nine-foot Kanawha project in attracting new industry and quickening the tempo of waterway commerce were soon apparent in the Kanawha valley. Tonnage on the river nearly doubled between 1927 and 1936; shipments of petroleum and coal sharply increased; and, perhaps more important, chemical companies expanded and new chemical firms located along the Kanawha. The chemical industry invested $10 million in new plants along the Kanawha in 1935 alone—providing employment for thousands, stimulating the development of related secondary industries, and furnishing the Kanawha valley with a prosperity enjoyed by few other areas in the nation during the depression years.

Waterborne commerce on the Kanawha River, like that on the Ohio, began a steady upward spiral which made Gallipolis Locks and Dam, the largest in the world at completion in 1938, obsolete in less than forty years.

—From the Steamboat Photo Collection of G. W. Sutphin

Steamboat with coal tows passing the landing at Huntington after just leaving the nine foot slackwater pool created by the Kanawha project.

Chapter IX

A Back Door Approach to Flood Control

British Army Engineers Harry Gordon and Thomas Hutchins found it hard to believe. In January 1762, just a little more than a year before, they had witnessed a flood that washed away the carefully built ramparts of Fort Pitt, entered the magazines and destroyed ammunition stores, lifted houses from the nearby settlement and spun them down the Ohio toward Indian country, and so devastated the countryside that even the Indians had swarmed to Fort Pitt for flood-disaster assistance. Now, in March 1763, here the Engineers were again, soaked to the skin by persistent rains, and pulling at the oars of their skiff to get supplies out of Fort Pitt before the flood waves lapping at the ramparts began to trickle into the interior of the fort.

The river continued its inexorable rise, surpassing the height of the 1762 flood by a foot and a half and cresting on March 8, 1763, at 41 feet, sixteen feet above flood stage at Fort Pitt. A trader at the Fort Pitt settlement said the flood entered the streets of the village about noon on March 8, and the settlers "began to muster off, but ye dead Faith of Several promp'd 'em to delay carrying away their Goods until ye Water was got so high that they had to break in ye Roofs or Gable Ends of ye Houses to get them away in Battoes."

The 1763 flood took two lives at Fort Pitt, the Engineers said in the first report on an Ohio River flood disaster, and the water swept away gardens, fences, and outbuildings and left a deep layer of mud and slime in the fort and nearby buildings.

Only Indians lived along the Ohio River below Fort Pitt in 1763 and no records of downriver flood stages were made, but at the head of the river the 41-foot crest of the 1763 flood was the record until surpassed in 1936. During the quarter-century after 1763, American pioneers at frontier settlements like Marietta were often warned by Indians that they were building their homes in the floodplain. The Indians pointed up into the trees, saying they had tied their canoes to an upper branch, but the settlers merely laughed, and built their cabins where they pleased.

Floods were, after all, an act of God, about which nothing could be done, and, besides, the floods gave the pioneers an opportunity to launch flatboats and ships and proceed down the inland rivers to New Orleans while rocky, snag-strewn channels were submerged far below the flood level. The pioneers described some of the early floods with amusement as "pumpkin floods," because pumpkins and squash floated downriver on the flood and pumpkins comprised the principal flood loss. But as the valley became more densely settled and businessmen located at riverside to take advantage of convenient water supply and easy access to transportation, the people of the Ohio valley began to view floods with less complacency.

Remedies Sought for Flood Destruction

By 1832, settlements along the Ohio had been built nearly to the edge of the river at normal stages, and when heavy February rains swelled the stream to a stage of 50 feet at Parkersburg, 58 feet at Letart Falls, 54 feet at Gallipolis, and 62.5 feet at Cincinnati, the people at riverside paid dearly for disregarding the warnings the Indians had given. From Pittsburgh to the mouth of the Ohio, all business was suspended at every town except Gallipolis, which was on high ground beyond reach of the flood, and every town was left "wretchedly desolated" with its citizens in "dire distress."

Boards, fences, haystacks, carriages, furniture, barrels of flour and pork, dead cows, and over a thousand homes tumbled downriver on the crest of the 1832 flood. The firehouse at Marietta, together with its engine and buckets, majestically floated south to become, six days later, a part of the Louisville Fire Department. Murky water stood eight feet deep in Portsmouth, and only the roofs of houses broke the current in low-lying sections of Aberdeen and Maysville. The editor of the *Maysville Eagle* declared the Maysville riverfront was truly a melancholy scene, with debris piled in an immense jam and homes steadily leaving for New Orleans.

Flood victims in 1832 and for a hundred years thereafter had to rely on their own resources in recovering and rebuilding after floods, and no one except Charles Ellet thought anything much to prevent floods could be done, except perhaps build a few levees around towns to keep out all but the highest floods. Federal flood control activities were out of the question during the early nineteenth century, for even the improvement of navigation on the inland rivers was opposed for constitutional reasons.

Engineer planning studies as a contribution to national welfare were accepted as a proper federal activity, however, and in 1850, after several destructive floods along the lower Mississippi, Congress created an engineer board, with Colonel Stephen H. Long, Captain Andrew A. Humphreys, and Charles Ellet as members, to study the Mississippi River flood problem. Ellet proposed a comprehensive plan for levees along the lower Mississippi, to be supplemented by dams and storage reservoirs in the Ohio, Kanawha, Missouri, and upper Mississippi basins for navigation, hydropower, and flood control, but in 1857 Congress rejected detailed studies of the Ellet plan. Captain Humphreys and his principal assistant, Henry L. Abbot, published a classic study of flood hydrology in 1861, and, after the interruption of the Civil War, they continued their studies in 1866.

General Humphreys (Chief of Engineers, 1866-79) and General Abbot, when a record flood ravaged the lower Ohio River basin in 1867, directed W. Milnor Roberts and Colonel William E. Merrill to collect complete flood data and assess the flood-height reductions the reservoirs proposed by Charles Ellet might have effected. Milnor Roberts said his data analysis indicated the control of Ohio River floods would be impossible "by any human means attainable within the practicable limits of cost," and Colonel Merrill, noting that Ellet had proposed dams of up to a hundred feet high, declared the engineering problems, in 1870, were practically insoluble. Merrill said:

> To build a dam 50 feet high in a running stream is excessively difficult. Reservoirs even built perfectly dry, where you can watch every stone, sometimes burst, and even when you select your ground for the very purpose it is difficult to prevent water under such a heavy pressure of 50 feet . . . at least getting around the sides even if not going through the dam.

A breached dam, said Merrill, could pour a "frightful wave of destruction" on the valley below the dam, with losses of life and property beyond imagination. To build dams and reservoirs with sufficient capacity to control the extraordinary Ohio River floods would be enormously costly, he concluded, because farms, villages, oil wells, mines, and manufacturing plants would be submerged by the reservoirs, and roads and railroads in the river valleys would have to be relocated.

Milnor Roberts and Colonel Merrill thus quashed serious consideration of the Ellet multipurpose reservoir plan for the time being, and in 1870 their criticisms of the reservoir concept were justified. High dams built in the nineteenth century did fail—notably the South Fork of Conemaugh River Dam above Johnstown, Pa. in 1889—and when Congress approved the construction of multipurpose reservoirs in the twentieth century the Corps of Engineers found the costs of land acquisition and relocations were indeed enormous.

Nevertheless, as population density in the inland river valleys increased, as industry and business located in the floodplains to secure the advantages of water supply, level land, and waterway transportation, and as near-annual floods caused ever-mounting damages, support for some federal action to deal with floods grew, in Congress and out. Ohio Congressman James A. Garfield, the Union officer who had a memorable experience with Big Sandy River flooding in 1862, declared in 1879 that floods on great interstate streams like the Ohio and Mississippi rivers were far "too vast for any State to handle; too much for any authority less than that of the nation itself to manage." In 1879 Congress took its first hesitant step toward a national flood control policy by authorizing improvements in the flood levee system along the lower Mississippi River as a benefit to navigation.

The first federal flood control projects in the Ohio River basin were also approved by Congress, as a benefit to navigation, after two record floods prostrated the region in 1883 and 1884. The February 1883 flood in the central and lower Ohio valley exceeded some of the records set in 1832 by as much as three feet, and the people at riverside thought the flood havoc of 1883 would be the climax. But the valley communities had scarcely recovered from the 1883 disaster when the historic "Valentine's Day Flood" of February 1884 smashed its way to the Mississippi.

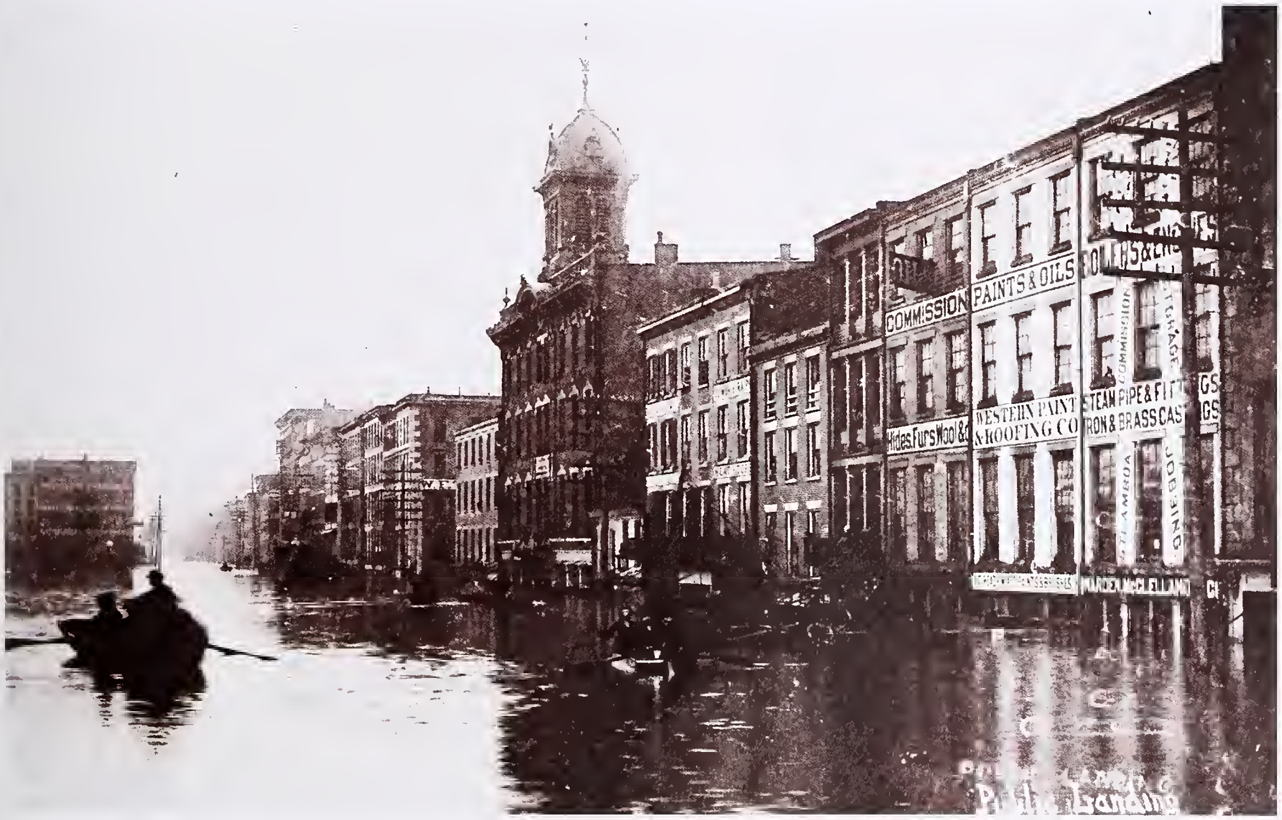
When melting snows and torrential rains brought the Ohio River to flood stage in late January 1884 the wiser residents of riverside towns moved their household furnishings and business wares to "safety" above the high water mark of 1883. And lost everything they had. The 1884 flood crested several feet above the 1883 marks. Water flowed fourteen feet deep in the main street of Marietta, and damages were estimated at over a half million dollars. Pomeroy, New Richmond, and Manchester, Ohio, were heavily damaged. Cochransville, Ohio, had forty-five houses before 1884; the flood left only five. Barges tied up at the corner of Second and Chillicothe streets in Portsmouth, damages exceeded a million dollars there, and several homeless people died of exposure. Racine, Ohio, was described as resembling "a child's playboard after he has wearied of his sport and left it with the toy houses lying about in confusion"; 150 of the 250 homes were wrecked, washed away, or knocked from their foundations.

Conditions were just as bad at crossriver towns. Only six of fifty buildings were left standing at Belleville, W. Va. The Kanawha River was a mile wide at its mouth, and four feet of water stood in parts of Point Pleasant which had escaped the flood of 1883. Guyandotte and Huntington were devastated by a flood crest of 62.9 feet—water was six feet deep in stores in Huntington, refugees boarded steamers to flee the city, and the mountaineers of Logan County floated out of the Guyandotte River into Huntington on pushboats to rescue marooned people and save property.

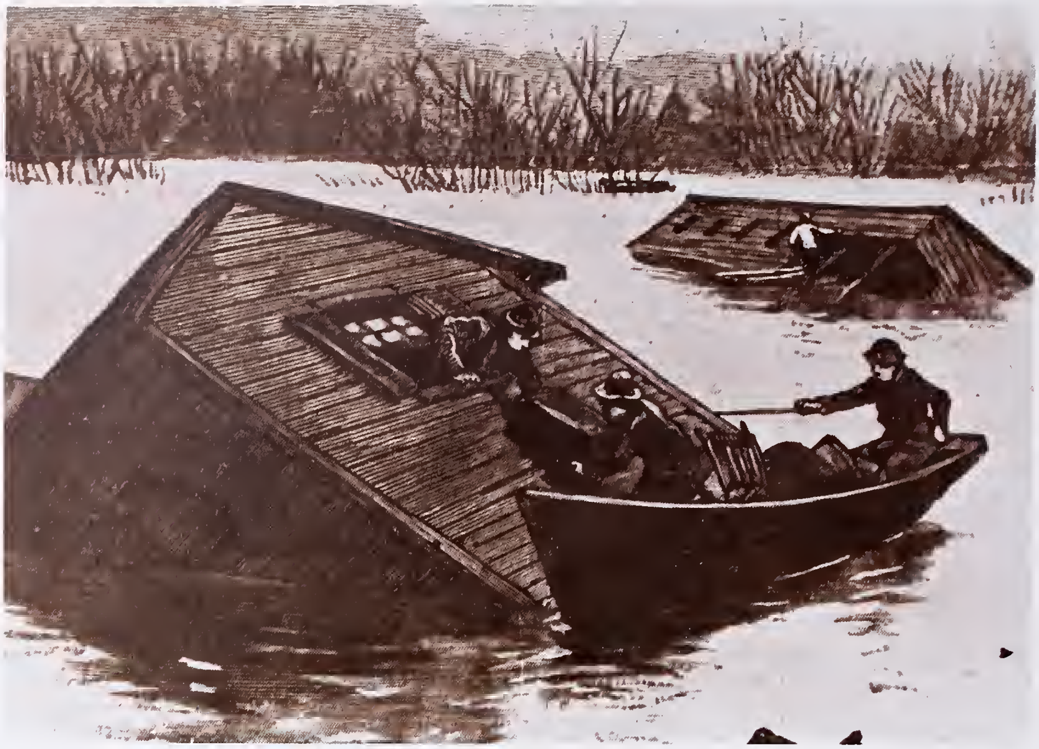
As news of the scope of the Valentine's Day debacle spread, a massive flood relief effort was organized to supply the distressed communities with emergency food, clothing, and blankets. The Gallipolis Citizens' Relief Committee dispatched the steamers *Champion*, *Telephone*, *Nora Belle*, *Jim Montgomery*, *New Era*, *Claribell*, and *Chesapeake* to distribute relief supplies along the river from Portsmouth to Marietta. The Pittsburgh Relief Committee delivered supplies downriver aboard the steamers *Iron City* and *Resolute*. And the Cincinnati committee sent necessities upriver aboard the *Granite State*. Clara Barton, first president of the American Red Cross, moved up and down the Ohio on the *Josh V. Throop* and *Mattie Hays* to aid flood victims. These boats had to dodge debris floating down on the flood and bullets fired by people on the banks and rooftops who feared waves from the passing boats would shake their flooded homes from their foundations and send them bobbing downstream.

State governments made appropriations to purchase emergency supplies for refugees, and Congress approved disaster assistance for flood victims. The Quartermaster Department of the Army was authorized to distribute $300,000 worth of relief supplies aboard chartered steamboats such as the *Katie Stockdale*. Army Engineer boats like the steamer *Bee*, sent by Addison Scott down the Kanawha, were also placed in relief service for the Quartermaster Department.

A reporter for *Harper's Weekly* estimated that two thousand homes floated down the Ohio on the crest of the 1884 flood and commented that the flood would have many serious long-range effects:



Public Landing in Cincinnati during the historic Valentine's Day flood of February 1884.



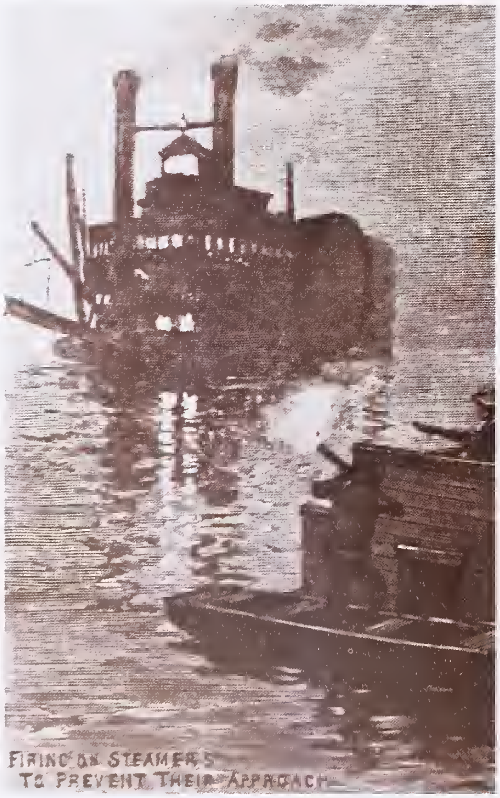
"Harper's Weekly" 1884

Lithograph depicting looters and wreckers during the flood of 1884.

> The farmers lost largely of their horses and cattle, nearly all their grain and feed, and all their fencing. The merchants and manufacturers lost their stocks, and the mechanics were out of employment. Coal mines and salt works were flooded, and everything is desolate indeed. It will be weeks and months before business can be resumed, and help will be needed long after the waters have subsided.

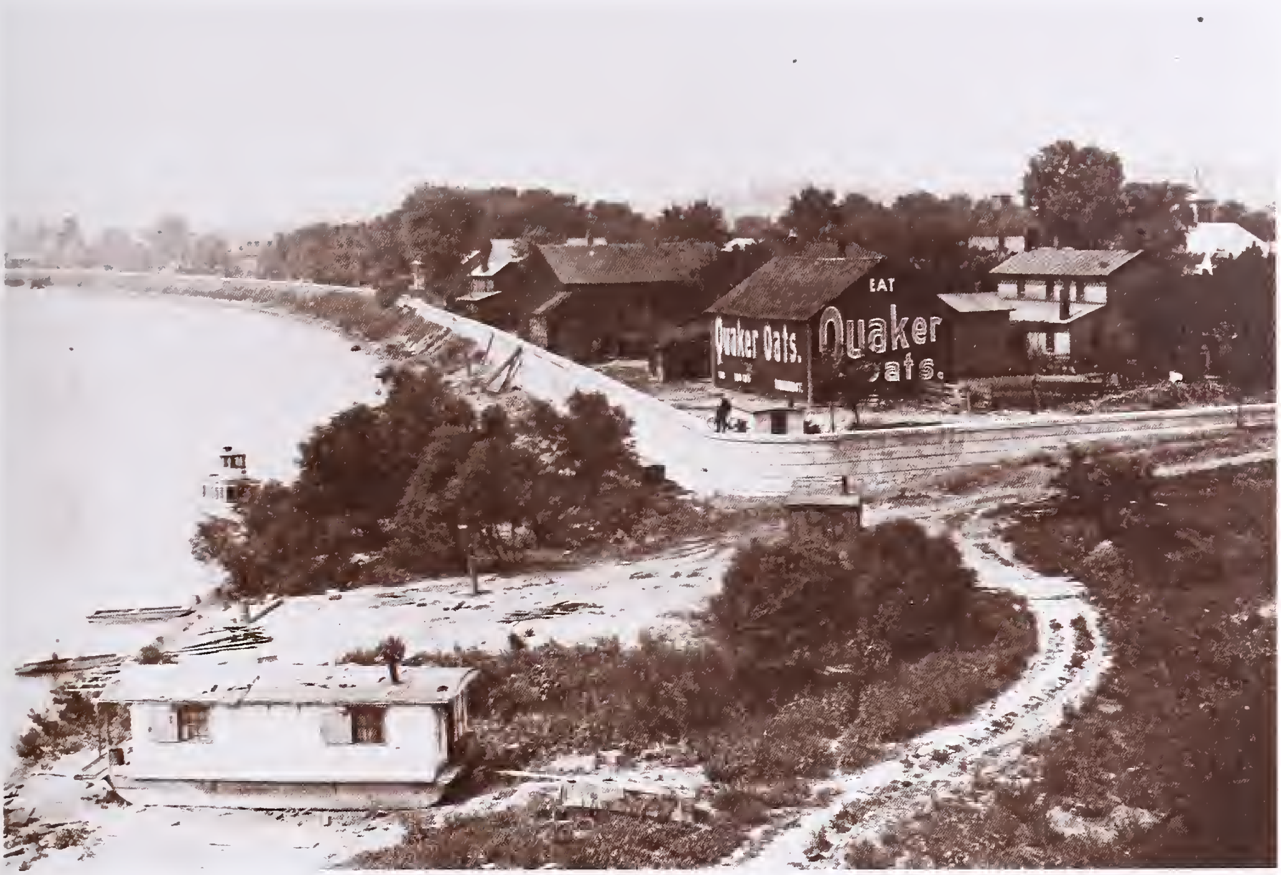
The Valentine's Day Flood of 1884 generated major public support for some federal action to control floods and reduce their catastrophic effects on community affairs. One writer in *Engineering News*, an influential professional journal, suggested that, in view of the "appalling and annual loss of life and property in the Ohio Valley from floods," the construction of reservoirs for flood control be reconsidered by Colonel Merrill, the Corps of Engineers, and Congress. Construction and land acquisition costs might be high, the writer observed, but reservoirs built on cheaper lands along Ohio River tributaries might actually save millions more than they cost by preventing flood havoc in the cities and towns along the main stem.

Congress was not prepared to approve construction of flood control reservoirs and dams in 1884, nor was it ready to approve any flood control measures as part of a national policy for flood prevention, but in the aftermath of the Valentine's Day Flood it did authorize construction of



"Harper's Weekly" 1884

Lithograph showing residents firing on steamboat to prevent more damage from wave action.



Muskingum River at Zanesville, Ohio, looking downstream showing old levee repaired by U.S. Government in 1898 under special order diverting funds originally appropriated for Cleveland Harbor.

levees around Jeffersonville and Lawrenceburg, Ind. and Shawneetown, Ill. on the lower Ohio River—not for flood control but to benefit navigation by keeping boats in the channel and out of town during floods.

How Justify Flood Protection?

Colonel Merrill, whose sobriquet "Padre" was not unearned, protested loudly and publicly that levees were of little if any benefit to navigation. If Congress wished to build levees around towns subject to inundation, Merrill declared, there were no places which needed such protection more than the desolated towns along the Ohio, but not as a benefit to navigation. Merrill and the Engineers carried out the mandate of Congress in this, as in all else, but the construction of levees as a benefit to navigation was performed over their annual protest.

The "back door" approach to flood control as a benefit to navigation was taken by Congress in 1898, when it approved the repair and extension of a floodwall and levee at Zanesville on the Muskingum as a benefit for navigation in the harbor of Cleveland, Ohio! The Zanesville wall and levee, known as the Linden Avenue Levee, was originally built in 1836 to prevent bank erosion along the Zanesville riverfront. Citizens of Zanesville donated funds to repair and raise the wall after an 1860 flood breached it; and after floods in 1869 and 1884 damaged the wall it was repaired by the state of Ohio. The state believed responsibility for maintenance of the Zanesville floodwall was delivered to the United States along with the Muskingum slackwater project in 1887, but part of the wall was located on private lands not owned by the state, and the benefit of the wall to navigation was questionable.

When a record flood in March 1898 again overtopped and breached the old wall, master politician Marcus A. Hanna, Senator from Ohio and campaign manager for President William McKinley, inserted an item in an appropriations bill of 1898 which read: "Improving harbor at Cleveland, Ohio: For continuing improvement, three hundred thousand dollars: *Provided*, That six thousand dollars of said sum may be used for the repair and extension of the levee of the Muskingum River at Zanesville, Ohio."

The Cincinnati District Engineer informed the Chief of Engineers the Zanesville floodwall had nothing to do with navigation, had no connection with the improvement of Cleveland harbor—was not even in the same watershed—and to perform the work would be a "decided impropriety." The Chief of Engineers responded that Congress obviously intended the work should be done, and it must be done as directed.

The Cincinnati District Engineer negotiated an agreement whereby Zanesville donated easements for the floodwall and would maintain the wall after it was repaired. In 1899 and 1900, Assistant Engineer Edmund Moeser directed repairs to the old masonry wall, the installation of concrete coping atop the old wall to raise it, and the extension of the wall 575 feet by building an eight-foot base-width, fourteen-foot high concrete wall—the first concrete floodwall built by the Corps of Engineers in the Ohio River basin.

When another portion of the old wall failed in 1910, C.U. Shryock, president of the Zanesville Chamber of Commerce, asked the Army Engineers to repair it. The Engineers again reported the wall had nothing to do with navigation and pointed out that Zanesville had agreed to maintain it after it was repaired in 1900. Nevertheless, Senator Theodore E. Burton of Ohio, who made a national reputation as an opponent of waterway "pork barrel" projects, shepherded an appropriation through committee for the Zanesville floodwall in 1910, and the wall was again repaired by the Engineers as a benefit to navigation. "The wisdom of Congress surpasses all understanding," one Engineer officer said confidentially.

Sparked by the havoc wreaked by floods in the Ohio valley in 1905, 1906, and 1907, public interest in flood prevention engineering was widespread during the administration of President Theodore Roosevelt, and many ingenious flood control schemes were advocated. The "sternwheel backer-upper" method envisioned sternwheel steamers stationed at strategic points on tributaries when floods appeared imminent. The boats were to be firmly moored with bows pointed downstream, and at the proper moment paddlewheels would be operated under a full head of steam to back surplus water upriver. Thereby preventing floods? Another budding engineer proposed drilling deep holes to convey flood waters harmlessly to the substrata, and another suggested excavating "gutters" parallel to rivers to carry off surplus water. One electric wizard devised the "hot-wire" plan, involving the installation of electric wires a few feet above normal river stages; the wires were to be activated when floods swept down river and produce sufficient heat to convert the flood to steam.

Eager to get the approval of Congress for the creation of National Forest preserves, certain members of the Roosevelt administration took advantage of a popular misconception that flood hazards were greatly increased and regular

The March 1907 flood and the floods of 1905 and 1906 at Athens, Ohio sparked widespread public interest in flood prevention engineering during the administration of President Theodore Roosevelt.

streamflow disrupted by deforestation; and that flood heights could therefore be reduced, and increased riverflow for navigation provided, by planting trees on the hills denuded by man in his quest for marketable timber.

The Army Engineer hydrologists had long memories, however, and pointed out that Thomas Hutchins and British Army Engineers had witnessed destructive floods at Fort Pitt in 1762 and 1763, when the entire region was still covered by virgin forest. Captain John Sanders of the Corps had commented in 1843 that the Ohio River and its tributaries had always been subject to both floods and droughts. "I cannot discover that it was ever different," he said, "and we have some knowledge of the river since 1760 . . . so there is no cause of alarm from the portentous prophecies of those philosophers who imagine our rivers are to dry up with the clearing of forests."

During the Theodore Roosevelt administration, Corps personnel maintained that, while reforestation could benefit small watersheds, stripping the hills of trees had not increased flood heights or decreased summer streamflow on the Ohio. Increased flood damages were, instead, the result of constantly growing population and greater structural and commercial development in floodplains. The Engineers supported the creation of national forests, but not as a benefit to navigation. Nevertheless, Congress still in 1911 authorized the purchase of lands for National Forests in part as a benefit to river navigation, and the Corps of Engineers was rewarded for its honesty with bitter public attacks on the organization as "petrified conservatives" and enemies of the goals of forestry and forest preservation.

Similar attacks on the Corps were made during the Roosevelt administration for its alleged opposition to reservoirs for flood control.

New interest in the Ellet reservoir plan had been created by General Hiram M. Chittenden of the Corps, who after study of navigation and flood problems on the Missouri River wrote a classic report on the applications of multipurpose reservoirs. The Chittenden report, printed by Congress in 1898, asserted that multipurpose reservoirs could produce enough benefits to make them economically feasible. Marshall O. Leighton, Chief Hydrographer of the U.S. Geological Survey, in several brilliant papers printed in engineering journals between 1907 and 1912, reanalyzed the Ellet reservoir plans for the Ohio and Kanawha basins and launched a campaign in support of multipurpose reservoir construction as an excellent public investment, predicting that vast benefits could be realized through hydroelectric power generation, abatement of flood losses, and improved navigation.

Leighton argued that, by reason of technological and engineering advances, the objections to reservoirs raised by Milnor Roberts and Colonel Merrill were no longer valid, that the specter of dam failure and the fear of a repetition of the Johnstown Horror of 1889 would be groundless if the dams were built by the Army Engineers, and that suitable sites for reservoirs were available on Ohio River tributaries—the Scioto, Big Sandy, Allegheny, Monongahela, Licking, Kentucky, Guyandotte, Little Kanawha, Miami, and Kanawha rivers. He listed what he thought were seventeen excellent sites for flood control and multi-purpose reservoirs in the Kanawha River basin.

In proposing multipurpose reservoirs on the Kanawha, however, Leighton also attacked the slackwater lock and dam project as a waste of money that might have been more profitably expended on reservoir construction. This brought quick reaction from the hot-tempered Wheeling District Engineer, that "horrible example of petrified conservatism," Captain Frederick W. Altstaetter, who declared that reservoirs were advocated by experts in forestry and geology, but not by waterway navigation engineers. In an acrimonious article in an engineering journal, Captain Alstaetter wrote:

> In its revised form this project [Ellet reservoir system] has been made a more attractive pill for the country to swallow by saying that great water power could be developed at the various reservoir sites, that floods would be reduced, and that the tributaries would be improved at the same time; while on the tail of the project we find tied a proviso that forests would have to be planted in the watersheds above the reservoirs to keep debris from washing into them and filling them up. In this scheme large districts are flooded, people are driven from their homes, towns and smiling valleys are ruthlessly turned into reservoir sites; highways and railways are covered with the penned-up waters, farms are turned into forests, and we are calmly told that all these things are to be done in the interests of navigation. Truly, navigation is asked to carry a heavy burden.

General William H. Bixby, former Central Division Engineer who had become Chief of Engineers, agreed with Captain Altstaetter's summary of the situation. Multipurpose reservoirs could have great public advantages and should be looked forward to as exceedingly desirable, Bixby declared, but their construction costs could not be justified as a benefit to navigation alone. Congress, the Chief pointed out, would be reluctant to approve costly reservoir projects that would also entail a major extension of federal powers and authorities. General Bixby believed, however, that the time would come when the public would demand that floods be controlled and water resources fully developed, and when that time came Congress would find the authority and funds necessary to accomplish the task.

The Corp's insistence that neither reforestation nor multipurpose reservoirs could be economically justified as benefits to navigation made the organization extremely unpopular in the Theodore Roosevelt administration. The President declared it was a "poor business" to improve rivers for navigation alone when they could be made to serve many purposes, and he asserted that navigation could not be developed to the fullest extent without also controlling floods and increasing low water levels through storage reservoirs and drainage projects. The ebullient President bluntly proclaimed the Army Engineers were "necessarily unsuited by their training and traditions to take the broad view. . . . It is no longer wise or safe to leave the great work in the hands of men who fail to grasp the essential relations between navigation and general development and to assimilate and use the central facts about our streams."

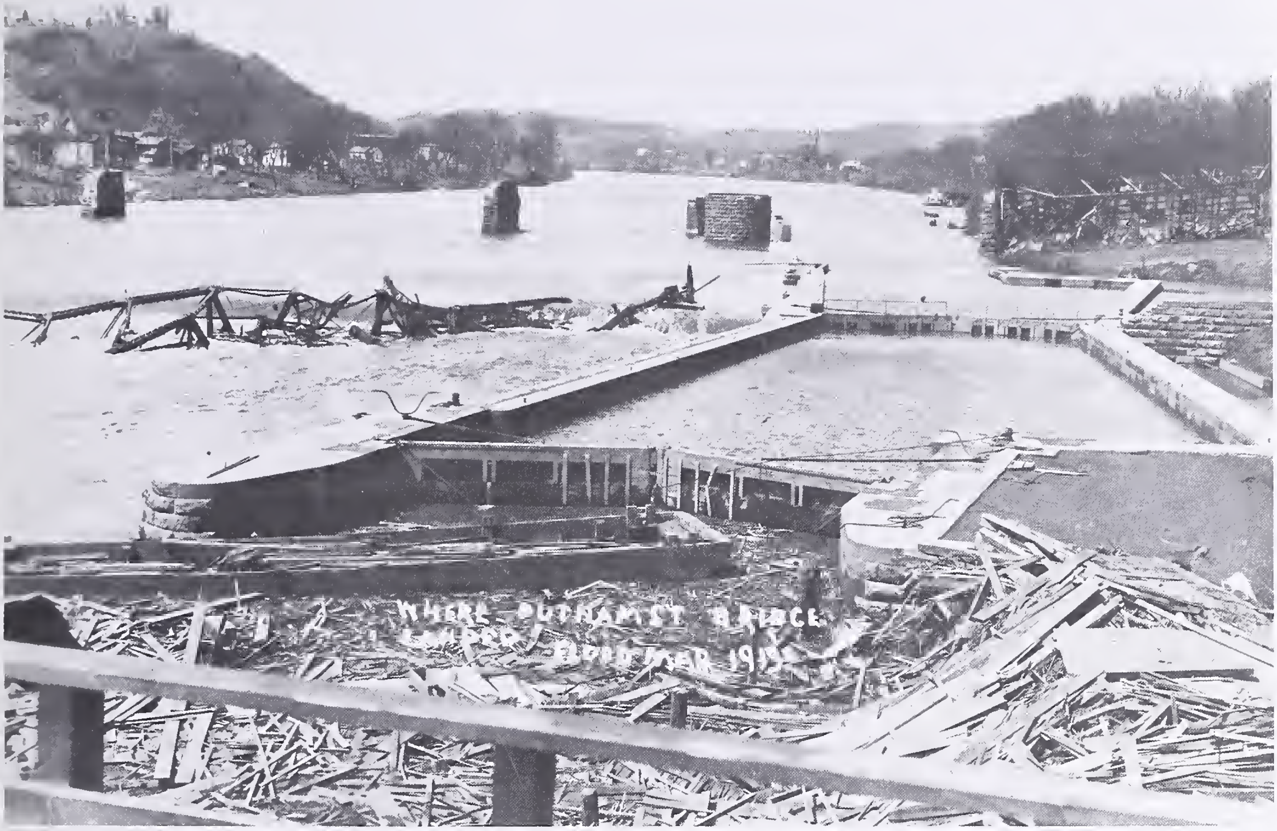
The National Waterways Commission, established by President Roosevelt and chaired by Senator Theodore E. Burton of Ohio, completed an intensive study of the reservoir issue in 1912. The Commission reported that reservoirs and related water resource programs were both feasible and desirable, especially in the Ohio valley, but that the federal government had no constitutional authority to undertake projects for flood prevention or power development. The prevention of floods was chiefly a local problem, the Commission said, and the United States could only participate in flood control programs to the extent that navigation was benefited. Public sentiment in support of federal action to reduce flood damages jumped sharply, however, after rampaging floods devastated the Ohio valley in 1913.

"Dayton Flood" Grips National Interest

A terrific, unprecedented rainstorm blew up the Ohio River basin and across central Ohio in late March 1913, dumping seven to ten inches of rain into the upper Miami, Scioto, and Muskingum basins and generating extraordinary floods that wrecked cities along those tributaries and the central section of the Ohio River. Heavy rains fell along tributaries flowing into the Ohio from the south, but flood heights in West Virginia and Kentucky were not cataclysmic, except at Williamson, W. Va., located at a point on Tug Fork

GLENWOOD AVE.
COLS O FLOOD 3-25-13

A typical street scene in Columbus, Ohio, during the flood of March, 1913. This flood was to be remembered as the "Dayton Flood," but many other central Ohio cities suffered proportionately more damage.



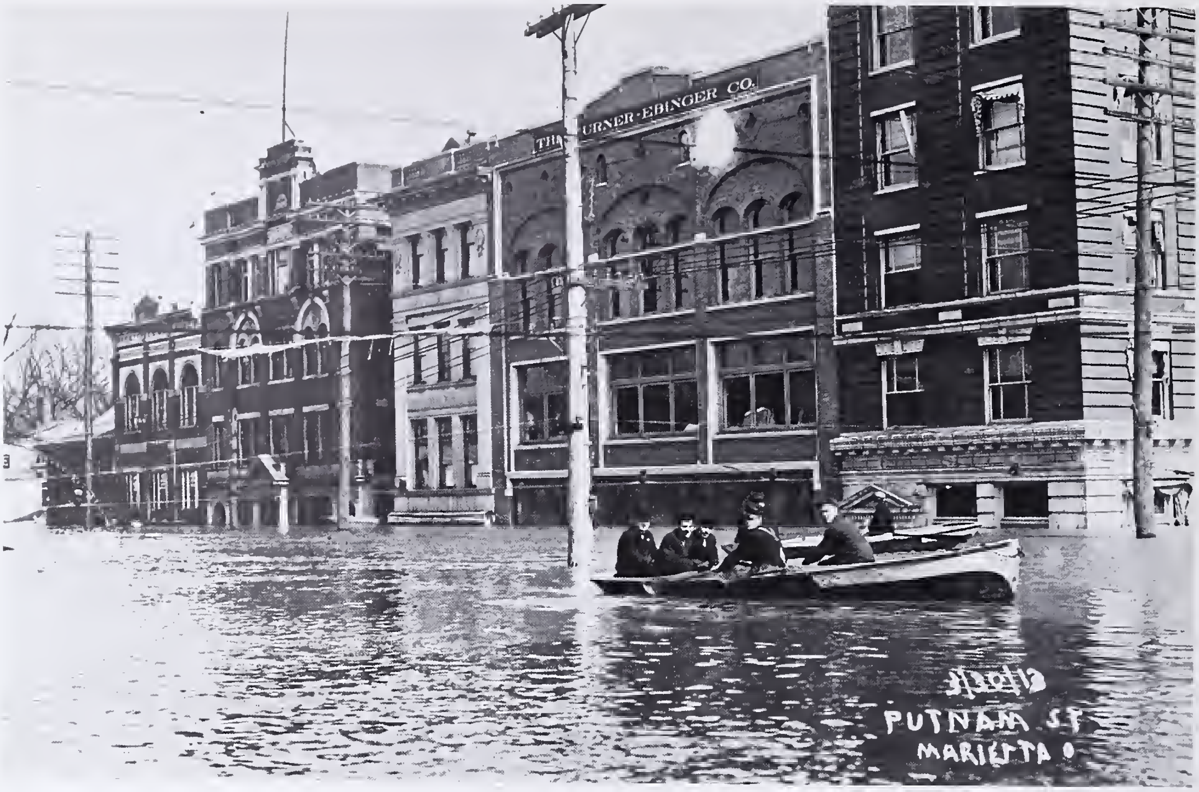
Muskingum River at Marietta, Ohio, after 1913 flood. View shows Lock and Dam No. 1 with wreckage from the Putnam Street Bridge lodged over the dam.

of Big Sandy River where even heavy dews posed flood threats. Homes, mills, lumber, bridges, railroad tracks, and people at Williamson were torn away by terrific torrents and swept toward Catlettsburg.

As the wind-driven rains lashed the basin and floods raced down the rivers bearing an immense twirling mass of human and wooden debris, Major Frederick W. Alstaetter, Wheeling District Engineer, got word from the Quartermaster Department that Congress would supply emergency flood relief as it had in 1884 and that the Corps of Engineers would distribute rations, tents, blankets, and other life-sustaining supplies aboard the Engineer fleet. Major Alstaetter sent the Engineer steamers *General Graighill*, *Guyandot*, and *Maimi* with supplies for flood sufferers to Parkersburg, Marietta, Huntington, and Catlettsburg. Assistant Engineer Thomas E. Jeffries at the Charleston suboffice cut the smokestacks off the *James Rumsey* so it could get under bridges and dispatched it and the launch *Nanina* down the Kanawha to join in the mercy mission.

The Engineer dredges *Ohio* and *Oswego* were securely tied to trees in the mouth of the Muskingum at the outset of the flood, but they were rammed by bridge sections floating down the flood-ravaged Muskingum and the trees were ripped from the ground, loosing the dredges to be swept down the Ohio. Engineer towboats caught the dredges and returned them to Marietta, where they were put to service rescuing people crying for help from second- and third-story windows.

T.G. Ridge and E.J. Carpenter, who had charge of the dredges, reported: "The conditions here in Marietta are beyond description. Nearly everyone in the flooded district has lost all their household goods and a great many of them all their clothes except what they wore." About 1,200 homes and the entire Marietta business district were flooded, to depths of eighteen feet in places. Houses and barns were swept away, the city was placed under martial law, and losses mounted to over a million dollars. The blankets,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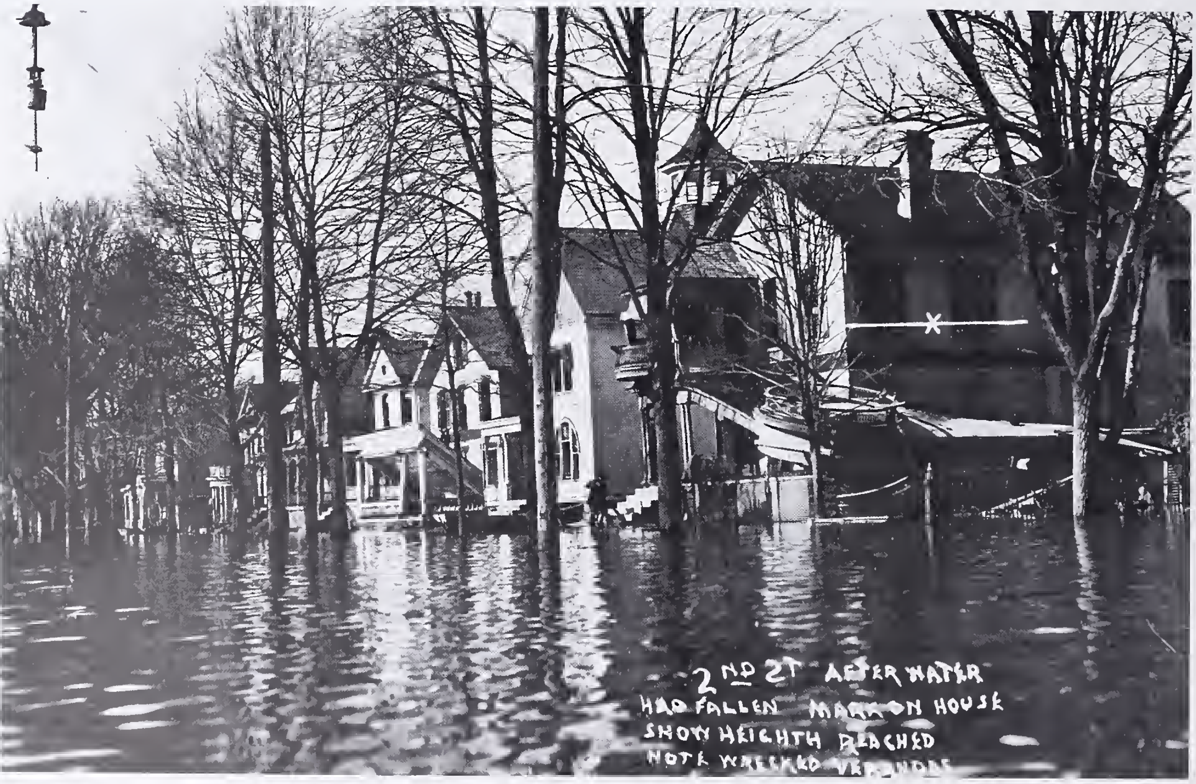
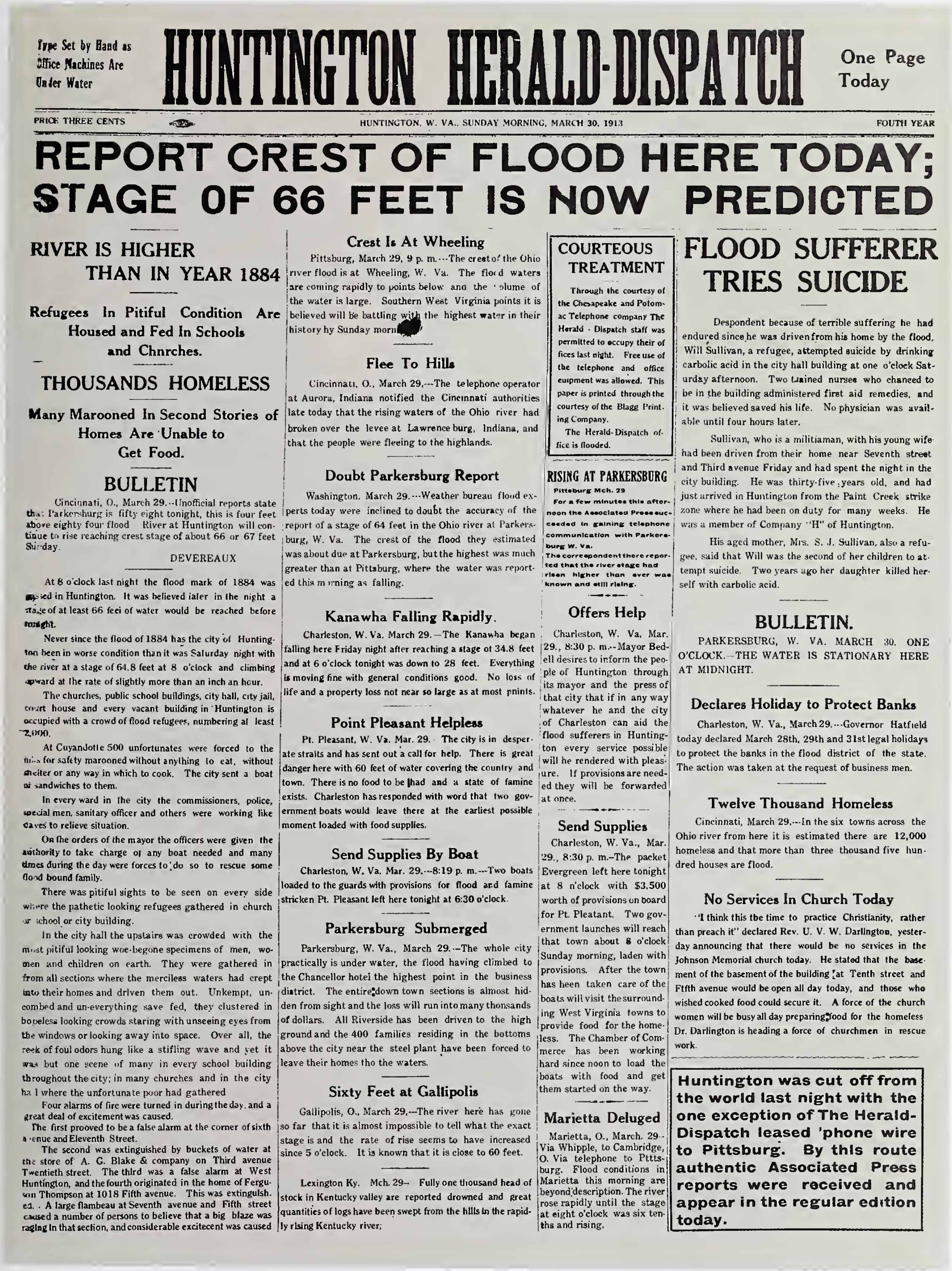
MARIETTA O

Downtown Marietta, Ohio, during 1913 flood.


2ND ST AFTER WATER
HAD FALLEN MARK ON HOUSE
SHOW HEIGHTH REACHED
NOTE WRECKED VERANDAS

Residential area in Marietta, Ohio, during 1913 flood. Note line on house showing the rest of the flood.



Type Set by Hand as
Office Machines Are
Under Water

HUNTINGTON HERALD-DISPATCH

One Page
Today

PRICE THREE CENTS — HUNTINGTON, W. VA., SUNDAY MORNING, MARCH 30, 1913 — FOUTH YEAR

REPORT CREST OF FLOOD HERE TODAY; STAGE OF 66 FEET IS NOW PREDICTED

RIVER IS HIGHER THAN IN YEAR 1884

Refugees In Pitiful Condition Are Housed and Fed In Schools and Chnrches.

THOUSANDS HOMELESS

Many Marooned In Second Stories of Homes Are Unable to Get Food.

BULLETIN

Cincinnati, O., March 29.--Unofficial reports state that Parkershurg is fifty eight tonight, this is four feet above eighty four flood River at Huntington will continue to rise reaching crest stage of about 66 or 67 feet Sunday.

DEVEREAUX

At 8 o'clock last night the flood mark of 1884 was passed in Huntington. It was believed later in the night a stage of at least 66 feei of water would be reached before tonight.

Never since the flood of 1884 has the city of Huntington been in worse condition than it was Saturday night with the river at a stage of 64.8 feet at 8 o'clock and climbing upward at the rate of slightly more than an inch an hour.

The churches, public school buildings, city hall, city jail, court house and every vacant building in Huntington is occupied with a crowd of flood refugees, numbering at least 2,000.

At Cuyandotte 500 unfortunates were forced to the hills for safety marooned without anything to eat, without shelter or any way in which to cook. The city sent a boat of sandwiches to them.

In every ward in the city the commissioners, police, special men, sanitary officer and others were working like slaves to relieve situation.

On the orders of the mayor the officers were given the authority to take charge of any boat needed and many times during the day were forces to do so to rescue some flood bound family.

There was pitiful sights to be seen on every side where the pathetic looking refugees gathered in church or school or city building.

In the city hall the upstairs was crowded with the most pitiful looking woe-begone specimens of men, women and children on earth. They were gathered in from all sections where the merciless waters had crept into their homes and driven them out. Unkempt, uncombed and un-everything save fed, they clustered in hopeless looking crowds staring with unseeing eyes from the windows or looking away into space. Over all, the reek of foul odors hung like a stifling wave and yet it was but one scene of many in every school building throughout the city; in many churches and in the city hall where the unfortunate poor had gathered

Four alarms of fire were turned in during the day. and a great deal of excitement was caused.

The first prooved to be a false alarm at the corner of sixth avenue and Eleventh Street.

The second was extinguished by buckets of water at the store of A. G. Blake & company on Third avenue Twentieth street. The third was a false alarm at West Huntington, and the fourth originated in the home of Ferguson Thompson at 1018 Fifth avenue. This was extinguished. . A large flambeau at Seventh avenue and Fifth street caused a number of persons to believe that a big blaze was raging in that section, and considerable excitecent was caused

Crest Is At Wheeling

Pittsburg, March 29, 9 p. m.---The crest of the Ohio river flood is at Wheeling, W. Va. The flood waters are coming rapidly to points below and the volume of the water is large. Southern West Virginia points it is believed will be battling with the highest water in their history hy Sunday morning.

Flee To Hills

Cincinnati, O., March 29,---The telephone operator at Aurora, Indiana notified the Cincinnati authorities late today that the rising waters of the Ohio river had broken over the levee at Lawrenceburg, Indiana, and that the people were fleeing to the highlands.

Doubt Parkersburg Report

Washington. March 29.---Weather bureau flood experts today were inclined to doubt the accuracy of the report of a stage of 64 feet in the Ohio river at Parkersburg, W. Va. The crest of the flood they estimated was about due at Parkersburg, but the highest was much greater than at Pittsburg, where the water was reported this morning as falling.

Kanawha Falling Rapidly.

Charleston, W. Va. March 29.—The Kanawha began falling here Friday night after reaching a stage ot 34.8 feet and at 6 o'clock tonight was down to 28 feet. Everything is moving fine with general conditions good. No loss of life and a property loss not near so large as at most pnints.

Point Pleasant Helpless

Pt. Pleasant, W. Va. Mar. 29. The city is in desperate straits and has sent out a call for help. There is great danger here with 60 feet of water covering the country and town. There is no food to be had and a state of famine exists. Charleston has responded with word that two government boats would leave there at the earliest possible moment loaded with food supplies.

Send Supplies By Boat

Charleston, W. Va. Mar. 29.---8:19 p. m.---Two boats loaded to the guards with provisions for flood and famine stricken Pt. Pleasant left here tonight at 6:30 o'clock.

Parkersburg Submerged

Parkersburg, W. Va., March 29.--The whole city practically is under water, the flood having climbed to the Chancellor hotel the highest point in the business district. The entire down town sections is almost hidden from sight and the loss will run into many thonsands of dollars. All Riverside has been driven to the high ground and the 400 families residing in the bottoms above the city near the steel plant have been forced to leave their homes tho the waters.

Sixty Feet at Gallipolis

Gallipolis, O., March 29,--The river here has gone so far that it is almost impossible to tell what the exact stage is and the rate of rise seems to have increased since 5 o'clock. It is known that it is close to 60 feet.

Lexington Ky. Mch. 29-- Fully one thousand head of stock in Kentucky valley are reported drowned and great quantities of logs have been swept from the hills in the rapidly rising Kentucky river;

COURTEOUS TREATMENT

Through the courtesy of the Chesapeake and Potomac Telephone company The Herald - Dispatch staff was permitted to occupy their offices last night. Free use of the telephone and office euipment was allowed. This paper is printed through the courtesy of the Blagg Printing Company.

The Herald-Dispatch office is flooded.

RISING AT PARKERSBURG

Pittsburg Mch. 29

For a few minutes this afternoon the Associated Press succeeded in gaining telephone communication with Parkersburg W. Va.

The correspondent there reported that the river stage had risen higher than ever was known and still rising.

Offers Help

Charleston, W. Va. Mar. 29., 8:30 p. m.--Mayor Bedell desires to inform the people of Huntington through its mayor and the press of that city that if in any way whatever he and the city of Charleston can aid the flood sufferers in Huntington every service possible will he rendered with pleasure. If provisions are needed they will be forwarded at once.

Send Supplies

Charleston, W. Va., Mar. 29., 8:30 p. m.--The packet Evergreen left here tonight at 8 n'clock with $3,500 worth of provisions on board for Pt. Pleatant. Two government launches will reach that town about 8 o'clock Sunday morning, laden with provisions. After the town has heen taken care of the boats will visit the surrounding West Virginia towns to provide food for the homeless. The Chamber of Commerce has been working hard since noon to load the boats with food and get them started on the way.

Marietta Deluged

Marietta, O., March. 29--Via Whipple, to Cambridge, O. Via telephone to Ptttsburg. Flood conditions in Marietta this morning are beyond description. The river rose rapidly until the stage at eight o'clock was six tenths and rising.

FLOOD SUFFERER TRIES SUICIDE

Despondent because of terrible suffering he had endured since he was driven from his home by the flood, Will Sullivan, a refugee, attempted suicide by drinking carbolic acid in the city hall building at one o'clock Saturday afternoon. Two trained nurses who chanced to be in the building administered first aid remedies, and it was believed saved his life. No physician was available until four hours later.

Sullivan, who is a militiaman, with his young wife had been driven from their home near Seventh street and Third avenue Friday and had spent the night in the city building. He was thirty-five years old, and had just arrived in Huntington from the Paint Creek strike zone where he had been on duty for many weeks. He was a member of Company "H" of Huntington.

His aged mother, Mrs. S. J. Sullivan, also a refugee, said that Will was the second of her children to attempt suicide. Two years ago her daughter killed herself with carbolic acid.

BULLETIN.

PARKERSBURG, W. VA. MARCH 30. ONE O'CLOCK.--THE WATER IS STATIONARY HERE AT MIDNIGHT.

Declares Holiday to Protect Banks

Charleston, W. Va., March 29.---Governor Hatfield today declared March 28th, 29th and 31st legal holidays to protect the banks in the flood district of the state. The action was taken at the request of business men.

Twelve Thousand Homeless

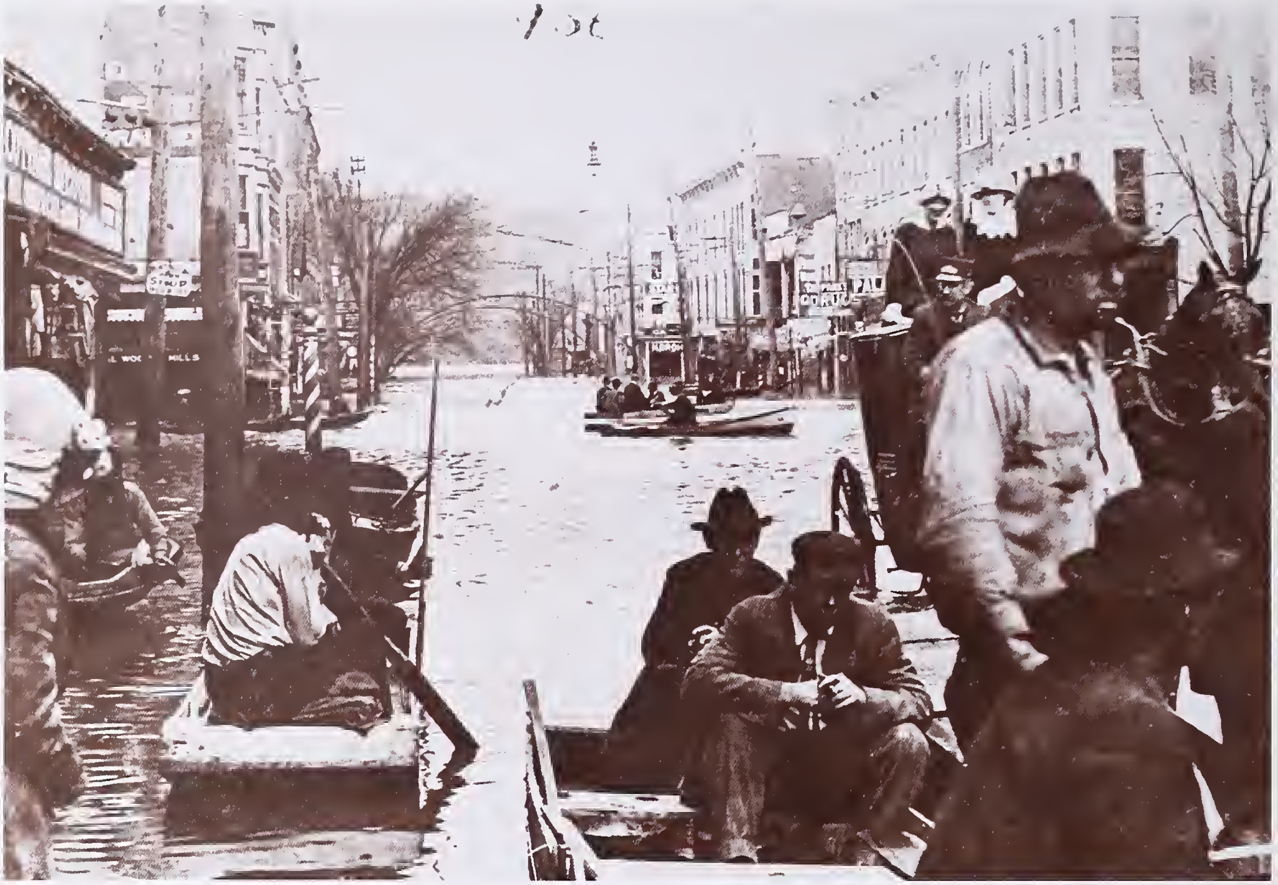
Cincinnati, March 29.---In the six towns across the Ohio river from here it is estimated there are 12,000 homeless and that more than three thousand five hundred houses are flood.

No Services In Church Today

"I think this tbe time to practice Christianity, rather than preach it" declared Rev. U. V. W. Darlington, yesterday announcing that there would be no services in the Johnson Memorial church today. He stated that the basement of the basement of the building at Tenth street and Ftfth avenue would be open all day today, and those who wished cooked food could secure it. A force of the church women will be busy all day preparing food for the homeless Dr. Darlington is heading a force of churchmen in rescue work.

Huntington was cut off from the world last night with the one exception of The Herald-Dispatch leased 'phone wire to Pittsburg. By this route authentic Associated Press reports were received and appear in the regular edition today.

One page, hand-set, SPECIAL



Looking north on Ninth Street in downtown Huntington during 1913 flood.

tents, and rations delivered to Marietta by the *James Rumsey* and the *Miami* were truly life-sustaining.

The 1913 flood covered the Parkersburg business district, climbing even to the Chancellor Hotel, the highest point in the downtown area. Point Pleasant was in "desperate straits," and was supplied by the *James Rumsey* on its trip down from Charleston. Half of Hockingport was submerged, and ten homes were washed away. The flood reached a stage of 66.2 feet at Huntington on March 30—citizens of Guyandotte fled for the hills, and Huntington was filled with refugees. According to the *Herald-Dispatch*, Huntington City Hall was crowded with the "most pitiful looking woe-begone specimens of men, women and children on earth," who had lost all to the merciless river.

The Army Engineers supplied Huntington and Catlettsburg with rations brought in by the *General Craighill* and the launch *Burke*. The men aboard these vessels assisted in restoring electric power and telephone service at Huntington, then steamed to Catlettsburg, where, at the request of the mayor, they took charge of the town, arranged cleanup work, organized efforts to feed the hungry, and supervised emergency medical work to prevent epidemic disease.

The March 1913 flood was to be remembered as the "Dayton Flood," because of the enormous loss of life and property at that city on the Miami River in southwestern Ohio, but Zanesville on the Muskingum suffered proportionately more property damage than did Dayton; and Columbus, Circleville, Chillicothe, and Delaware in the Scioto basin were as badly wrecked as the towns along the Miami.

The people at Zanesville thought no flood would exceed that of 1898, and they depended for protection on the old floodwall, built to three feet above the 1898 crest. The 1913 flood exceeded that of 1898 by fifteen feet at Zanesville: 3,400 buildings were flooded and 157 washed away, utilities were disrupted, and the sole bridge left standing was the famed Y-Bridge. Massillon, on the Tuscarawas, was almost entirely flooded, with utilities out and 300 families homeless. Similar conditions prevailed at most other communities along the Muskingum—eleven lives were lost, sixty-nine bridges were destroyed, and property damages were estimated at $14 million.

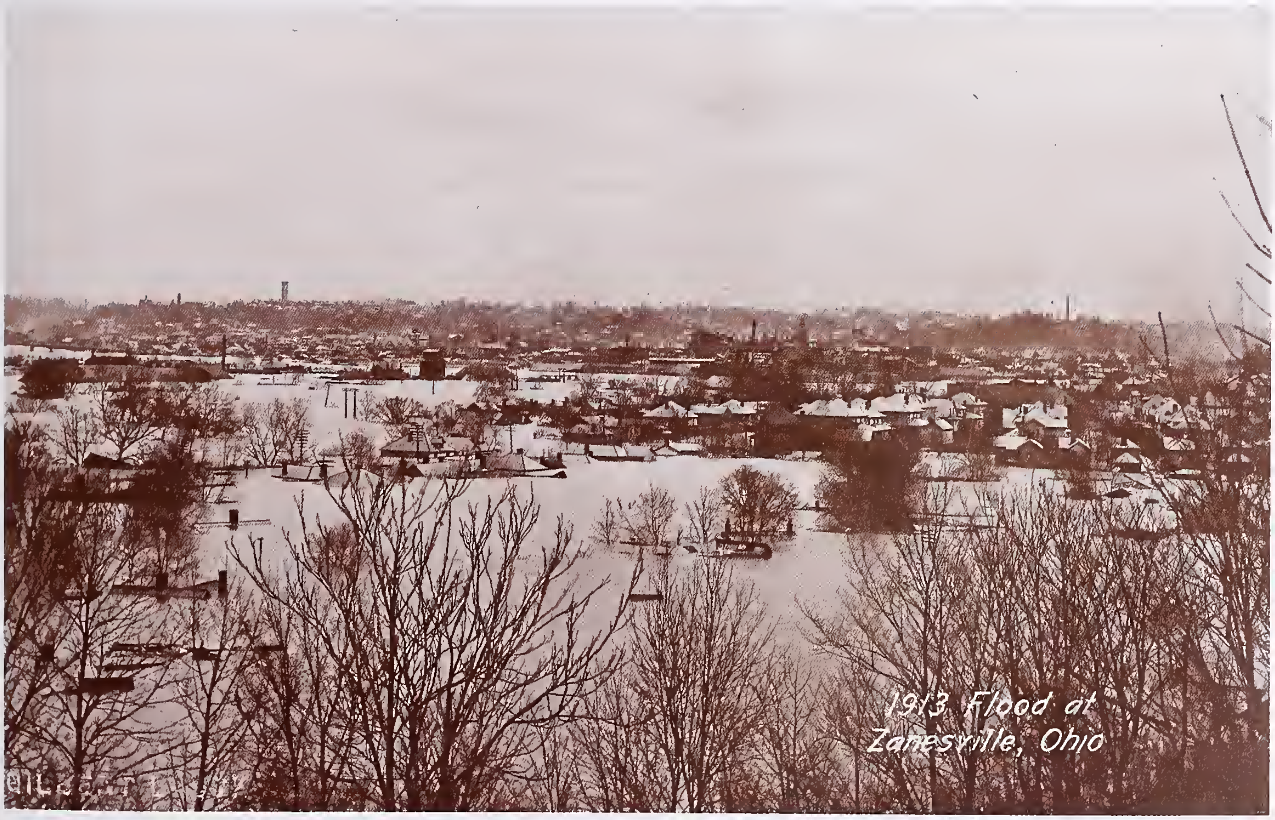
Julian Griggs, Columbus City Engineer, said that long before the 1913 flood it was known that

Columbus, at the junction of the Scioto and Olentangy rivers, desperately needed flood protection but it was also known that no funds for flood protection could be had "until a calamitous flood should occur . . . but no one ever had an imagination sufficient to visualize . . . the awful magnitude of the calamity when it finally came." Between March 23 and 27, 1913, seven inches of rain poured from the gray clouds over Columbus, eleven inches upriver at Marion and Bellefontaine, and a stupefying flood descended on the capital city, overtopping the low levees built after the 1898 flood. Rumors, though unfounded, spread that a water supply dam above Columbus had broken, and citizens frantically scrambled up into multistoried buildings for safety. Three hundred homes were totally destroyed and the bodies of ninety-three men, women, and children were dragged from the debris after the waters subsided.

Twenty miles north of Columbus, the Olentangy River rose eleven feet above previous records at Delaware, snuffing out nineteen lives, sweeping forty-eight homes downstream, driving 214 families from their homes, and destroying forty-one bridges in the Delaware area. Seventy-five percent of Chillicothe, down the Scioto from Columbus, was flooded, nineteen lives were lost, and damages aggregated over a million dollars. In sum, nearly every town and village in the Scioto basin suffered damages of unsurpassed severity.

The "Dayton Flood" of 1913 cost the people of the Ohio drainage basin about $200 million dollars, and, worse, it killed 415 people. Destruction of this scope was paralyzing and terrifying. In an outburst of national distress, quick action at all government levels to do something, anything, was demanded, to prevent floods or reduce their tragic costs.

Former President Theodore Roosevelt reacted to the disaster with rage. Millions were spent for flood relief, he cried, but not one cent for flood prevention! Levees should be built and strengthened, multipurpose reservoirs built for source-stream control, and all this might be done, he said, by a single brave act of Congress: "We can lift the rivers out of politics by enacting a single adequate measure, establishing a policy, and providing continuing funds, exactly as was



The 1913 flood was one the largest floods in the Ohio Valley in this century. Many homes were washed away in this area and the Muskingum project grew out of this flood.

MARRIATT ST LOOKING WEST
Zanesville O. 3/27/1913.

Another view of Zanesville Ohio, in the flood of 1913.

done in the case of the Panama Canal."

President Woodrow Wilson was also shocked, and declared the calamity in the Ohio basin made "clearer than ever before the imperative and immediate necessity for a comprehensive and systematic plan for drainage and flood control."

A few cautious notes were sounded. Colonel Curtis McD. Townsend, president of the Mississippi River Commission, for example, warned that while systematic water conservation and flood control were appealing, they could be the "voice of a siren luring the people to an open pork barrel for every stream in the United States." But men with such views were in the minority in the aftermath of the 1913 flood disaster; and both Ohio and the nation took long steps on the road toward flood control.

Ohio enacted the Conservancy Act of February 18, 1914, authorizing the formation of regional conservancy districts to deal with floods and related water resource problems. The Miami Conservancy District, in the drainage area where the "Dayton Flood" got its name, was organized in 1915. Its directors employed distinguished civil engineer Arthur E. Morgan, who planned and completed five retarding basins and related levee and channel improvements by 1922, greatly relieving flood hazards in the Miami valley. Similar conservancy districts were established in the Scioto River basin, without similar success. And the Muskingum Watershed Conservancy District was organized in 1933, and completed in 1938, in conjunction with the Huntington Engineer District and several other state and federal agencies, a flood control and water resource project that received worldwide recognition for its engineering and conservation innovations.

Action at the federal level was precipitated by the avalanche of requests for assistance that poured into the offices of the President, members of Congress, and the Chief of Engineers in 1913 from flood-devastated communities. Mayor James A. Cahill of Chillicothe told the Secretary of War that, because the Scioto River was a navigable water of the United States, citizens of Chillicothe believed the United States was responsible for stream conditions, and the mayor urged that Army Engineers be sent to assist the city in planning a flood protection project. Mayor George J. Karb of Columbus explained to the Secretary of War that a conservancy district was being organized in the Scioto basin to plan flood control dams on the upper Scioto and Olentangy rivers and that the help of the Army Engineers was needed in reviewing the plans and taking the flood protection issue "entirely out of politics."

FLOOD-JAN. 28-'18- PIKEVILLE. KY.
SECOND ST., COR. PIKE HOTEL 8.P.M.
PHOTO

Flood of 1918 on the Levisa Fork of the Big Sandy River.

A National Board Pursues Answers

President Wilson ordered the formation of a board of engineers to answer these and other requests and to undertake a study of possible avenues for federal flood assistance. No legal authority for such studies existed, but the Chief of Engineers drew up a carefully worded Special Order on April 12, 1913, appointing a flood board to report upon the "most practicable and effective measures for prevention of damage by floods to works constructed for the improvement of navigation, of interference with interstate commerce, and of other disastrous consequences thereof." The members of the flood board included Army District Engineers in the Ohio River basin, plus the Cleveland District Engineer.

The Ohio River Flood Board proceeded promptly into the flood-stricken region, visiting Chillicothe, Columbus, Zanesville, and sixty-three other communities, holding public meetings with local officials to discuss area flood problems and proposed solutions, and minutely inspecting flood damages to ascertain their causes. The board learned that most damages resulted not from actual inundation, but from destructive currents created by embankments, bridges, and other structures encroaching on the floodplains which reduced the flood-carrying capacity of river channels. The board reported:

> The obstructions which have been placed along the various streams ought never to have been put there and their construction should have been prevented, but since the control of rivers is in the twilight zone between the spheres of Federal and State authority, it developed that what was anybody's business was nobody's business, and no effective authority has been exercised by anybody.

The flood board recommended that the authority of the United States be extended beyond the actual limits of navigation to prevent further encroachments on floodplains. It also reported that moving structures out of floodplains, building flood control reservoirs and dams, dredging deeper and wider channels to increase flood-carrying capacity, and building levees for local protection were all viable means of flood prevention, and that no single method was better than another because conditions so varied from basin to basin that a method suitable for one area might not be effective in another. A flexible flood control program to permit use of all possible methods was considered imperative.

The board believed the principal issue was the extent the United States could or should participate in flood control programs. By existing law of 1913, the United States could only participate to the extent that navigation was benefited, but it was the opinion of the board that flood control should not be based on the "uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that accrue in the protection of life and property from loss."

Because a great deal of misinformation about floods and their causes was being spread by the news media, and because local agencies were groping toward flood protection measures without reliable hydrologic information and without consideration of what effect local projects might have on other communities on the rivers, the board recommended that the United States begin river basin studies to collect precise information for use in the planning of projects. Surveys and planning studies by the Army Engineers had long been accepted as an unquestionably constitutional activity whereby the United States could contribute to national welfare without committing national resources to actual construction or development, and in 1915 Congress approved Engineer flood control and water resource studies in the Kanawha, Muskingum, Scioto, and other river basins.

In 1915 and 1916 the Wheeling and Cincinnati Engineer Districts prepared the first reports on flood problems and possible flood prevention measures on several Ohio River tributaries. The Kanawha River basin study, for example, was prepared by District Engineer T.H. Jackson and Assistant Engineer Guy B. Bebout of Wheeling. They reported Kanawha River floods could be reduced by ten feet or more, eliminating the greater proportion of flood damages, by construction of reservoirs to store floodwaters; that is, by the method first suggested by Charles Ellet in 1850. Jackson and Bebout asserted the value of such reservoirs to Kanawha and Ohio River navigation would at least be sufficient to justify the costs of detailed surveys of eighteen potential reservoir sites. But the United States was on the verge of entering World War I when the Kanawha report was submitted in 1916 and the other surveys recommended were deferred until after the war and the postwar economic recession.

In 1925 Congress directed the Chief of Engineers to submit estimates of the costs of preparing comprehensive, detailed studies of water resource problems and all possible measures that might be taken for the benefit of navigation, generation of hydroelectric power, and reduction of flood damages in nearly all the major river basins of the nation. The Chief's cost estimates were submitted in 1926, and Congress approved the planning studies in 1927. Because the cost estimates were printed in House Document No. 308, 68th Congress, the basin reports subsequently became known as the "308 Reports," or the "308 Surveys."

The "308 Reports" outlined the ultimate possibilities of each river basin for developments for navigation, power production, and flood control, and they represented the full commitment of the Army Engineers to the concept of multipurpose water resource development projects rather than those concerned with navigation only. These reports, described as the most ambitious planning program ever conceived and executed in the annals of waterways engineering, laid the groundwork and became the foundation for the Army Engineers' comprehensive water resource program.

"The entire design may not be worked out in our lifetime or in our children's lifetime," said the Chief of Engineers in 1930, "but the entire design will be known to us now."

Though it authorized planning studies and approved isolated flood protection projects as a benefit to navigation, Congress was still reluctant to embark on a comprehensive national program of flood control and water resource development that would entail vast costs and a major extension of federal powers. Arthur E. Morgan, engineer of the Miami Conservancy District, commented in 1928 that the United States was slipping through the back door to flood control. He said:

> We are now living under a hypocritical fiction. Improvement of navigation being under federal control, is made the excuse for flood control. By gradual accumulation of precedent we are, in fact, amending the Federal Constitution, but in such a partial and inefficient manner that the Federal Government is acquiring obligations for flood control without the necessary powers for its proper execution.

National policy and legal machinery for flood control, Morgan said, should be as well built and as comprehensive as the engineering design, and this was precisely the point personnel of the Corps of Engineers had been trying to maintain since the turn of the century. Improved navigation should not be the excuse for planting trees, building levees and walls for flood protection, or building reservoirs for flood control and hydropower production. A forthright national flood control policy was imperative.

But it was only after another catastrophic Ohio River flood swept down the valley that Congress was ready to open the front door and plunge into the flood fight!

Chapter X

Reaching The Front Door To Flood Control

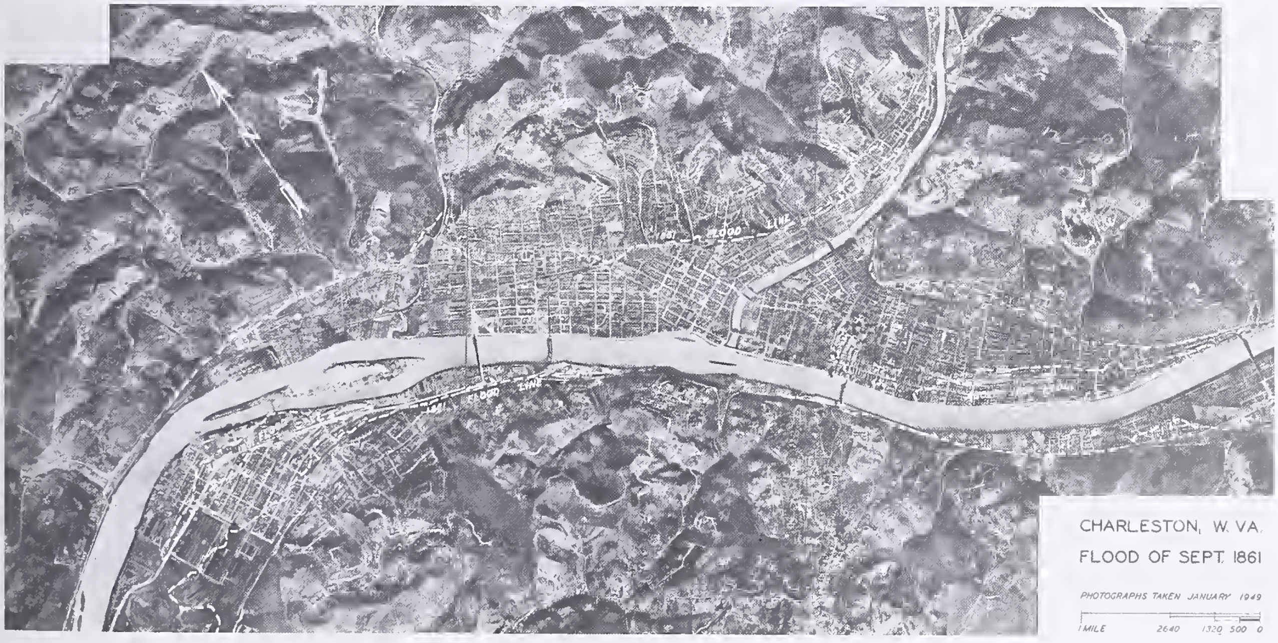
Charles Ellet would have been proud of Bluestone Dam, called the *"Guardian of the Chemical Center of the World,"* and equally proud of the multipurpose dams of the Muskingum River Lakes System, described as the *"Cradle of Soil and Water Conservation,"* because these two projects went far to achieve the goals he predicted could be accomplished through the construction of dams and reservoirs for flood control, navigation improvement, and pollution abatement. These two projects, begun in 1933 with funds allocated by the Public Works Administration for Depression work-relief, were the last of the "back door" projects for flood control in the Huntington Engineer District.

In 1936, when Congress opened the front door to flood control by formulating a national flood control policy, both projects became part of the comprehensive program for water conservation in the Ohio River basin.

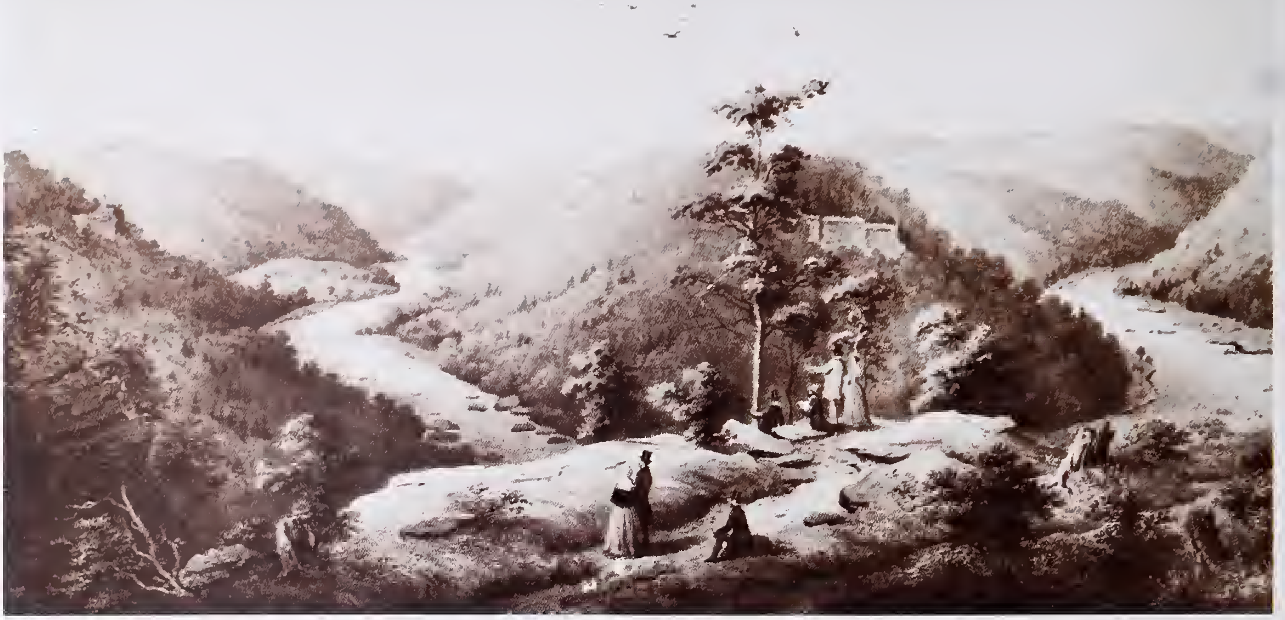
Crucial Preliminaries to Bluestone

Bluestone Dam and Reservoir (later renamed Bluestone Lake) was one of the four large storage reservoirs recommended by Huntington District Engineer Fred W. Herman in the "308 Report" on the Kanawha River basin submitted to Congress in 1932. In that landmark report, Major Herman and the Huntington District declared the four proposed reservoirs could contribute a great deal to reduction of the damaging floods that had ravaged the Kanawha valley thirty-three times between 1861 and 1931, most memorably in 1861 and 1878.

In 1861 the Kanawha River had risen at the furious rate of four feet in an hour, creating a current so strong that the Ohio River appeared to reverse its course and run upstream from Point Pleasant to Letart Falls. Floating buildings raced out of the mouth of the Kanawha, smashed into



Aerial mosaic plotting the area flooded during the flood of September 1861 at Charleston, West Virginia. Floods of this type are now controlled by three flood control dams above this part of the Kanawha River.



—Library of Congress

Early view from the Hawk's Nest, a state park overlooking New River.

Hawk's Nest Dam.

the north bank of the Ohio, and were carried upstream together with other debris to form a drift pile that completely closed the Ohio River channel for a time. At the time, Charleston had only 1,200 inhabitants and a few mills, but losses to the flood were heavy. The Kanawha salt industry lost its boats, wharves, and buildings, and this, in combination with the interruption brought about by the Civil War, ended the prosperity of the industry.

In the 1932 "308 Report," the Huntington District predicted that the Kanawha, under certain conditions, could produce a flood at Charleston as much as ten feet higher than the record flood of 1861, and, in light of the swiftly increasing population and rapid industrial development in the Kanawha valley, flood control measures were deemed imperative. But in 1932 projects for flood control were not usually approved by Congress, unless in conjunction with improvement of navigation. Major Herman suggested, however, that dams planned by private companies for the production of hydroelectric power might be so designed as to relieve some of the flood dangers, if cooperative arrangements could be worked out.

Private companies had been studying possible construction of dams to produce electric power on tributaries of the Kanawha since 1900. In 1923 Huntington District Engineer Milo P. Fox held hearings at Hinton on the application of the Virginia Power Company to build a 140-foot-high power dam on New River just above the present site of Bluestone Dam, and Major Fox had recommended that the power company be granted a permit because the proposed dam was of "primary importance for the conservation of power in this region." The Virginian Power Company made extensive studies of the project, but built nothing. On the other hand, the New-Kanawha Power Company built the famous $35 million Hawk's Nest Dam on the New River thirty-nine miles above Charleston between 1930 and 1936, diverting part of the flow of New River through a three-mile-long, thirty-foot tunnel to a point downriver where a 135,000 horsepower plant converted the 169-foot head of water into electric energy for use of a division of Union Carbide Corporation.

During the early Depression years, the Appalachian Electric Power Company began planning three New River dams for power production: the Radford (Claytor Lake) project in Vir-

Corps survey party proving that New River was still navigable in 1936.

ginia and the Bulls Falls and Pack's Ferry dams, upstream from Hinton and the site of the present Bluestone Dam. These plans led to a historic confrontation between the power company and the United States that had national implications. The power company maintained that New River was not navigable, and that it could, accordingly, build power dams on the stream without permission from the Federal Power Commission (FPC). The FPC and the Corps of Engineers believed New River was navigable and fought the case through the courts to the Supreme Court.

To prove New River had been and was a navigable stream, the Huntington District produced the official reports of General William P. Craighill on the keelboat navigation project built in the 1880's and records of interviews with people who recalled keelboats and steamboats on the river, and even located a Confederate veteran who could remember use made of the river by the Confederate Army for supply transportation. Patrick A. Gragnon and a party of four men were also directed to ascend the New River from Hinton in a sixteen-foot Engineer yawl, powered by an outboard motor, to prove that New River was still navigable. They reached Allisonia, Va. after several rough days travel up New River rapids and reaches, showing that the stream continued to be navigable in 1936.

On the basis of this evidence the Supreme Court determined in 1940 that New River was a navigable stream upon which the United States had the power to regulate commerce. Equally or more important was the decision of the court that commerce included not only navigation, but also "flood protection, watershed development, recovery of the cost of improvements through utilization of power," thus clearing away the legal tangle that had developed out of the "back door" approach to flood control in which Congress had been enmeshed prior to 1936.

While the New River case was in the courts, Huntington District began work in 1935 on Bluestone Dam, on the New River just above Hinton.

Construction photograph of Bluestone Dam.

Congressman John Kee of Bluefield, W. Va. had led a fight in the New River valley and in Congress during the early 1930's to secure approval for construction of Bluestone Dam for flood control and power production, against strong opposition from Appalachian Electric Power Company and citizens who believed the Bluestone project was a "pork barrel boondoggle" that might convert the beautiful New River valley at the reservoir site into "a despicable mudhole." Congressman Kee and other proponents of the Bluestone project won their fight in 1935, when President Franklin D. Roosevelt, a strong advocate of multipurpose water resource development, determined that the Bluestone project, in addition to its important flood control feature, could provide more uniform streamflow on the Kanawha, thereby reducing the effects of pollution and aiding Kanawha River navigation, and that it could also liquidate construction costs through sale of electric power generated at the dam. On September 12, 1935, President Roosevelt ordered the Secretary of War to proceed with construction of the Bluestone project with funds allocated from emergency relief appropriations.

Under this order, the Huntington District established a suboffice at Hinton to complete detailed surveys of the reservoir area and studies of foundation conditions; and two Civilian Conservaton Corps (CCC) camps were built in the vicinity to put young, unemployed men to work clearing trees and debris from the reservoir site. Actual construction of the dam was held up by an injunction obtained by the power company and an ensuing legal tangle that ended in the Supreme Court, and the District was not able to award a contract for construction until December 1941. This was a costly delay for residents of the New-Kanawha valley, for a destructive flood hit the area in August 1940, putting ten feet of water into Hinton, and the building of the dam had barely begun when the war with the Axis Powers forced suspension of construction until 1946.

Building the Muskingum Lakes

The fourteen-dam flood control and water conservation program in the Muskingum basin was completed with astounding celerity in five years, 1934 through 1938. The Muskingum project grew out of the 1913 flood, which dealt a devastating blow to the economy of the Muskingum area, eroding its farms, bringing new construction in the region to a standstill, and making parts of the area a dismal picture for the tax assessor. H.C. Van Voorhis of Zanesville had written Senator Warren G. Harding in 1919 to request the assistance of the Army Engineers in dealing with the desperate flood problems at Zanesville, and Senator Harding forwarded the letter to Colonel Lansing H. Beach, then Central Division Engineer at Cincinnati. Colonel Beach explained to Senator Harding that he had been stationed at Zanesville in 1888 under Colonel Merrill and had also served as a member of the flood board that had investigated the 1913 flood disaster in the Muskingum, and knew from personal observation that the only hope of protecting Zanesville and other parts of the drainageways from floods lay in the construction of dams and reservoirs for flood control.

Several Muskingum basin communities had studied measures to reduce flood damages during the decade following the 1913 flood, but they found that flood protection projects were far too costly for them to undertake independently. By 1928, civic leaders at Zanesville had determined that a basinwide cooperative program was necessary to achieve flood protection. Led by Bryce Browning and the Zanesville Chamber of Commerce, proponents of flood control organized the Muskingum-Tuscarawas Improvement Association and raised funds to employ Arthur E. Morgan, engineer of the Miami Conservancy District, to study flood protective measures for the Muskingum basin. Morgan reported in 1931 that the costs of flood control reservoirs would probably exceed local resources. And in 1932 the Huntington Engineer District, in its "308 Report" on the Muskingum, came to essentially the same conclusion:

> It is possible from an engineering standpoint to protect the upper main valley and portions of the principal tributary valleys from damage by a system of reservoirs as proposed in this report but the cost would be greater than justified by the benefits [to navigation] and there appears to be no feasible method of financing the required expenditure at the present time.

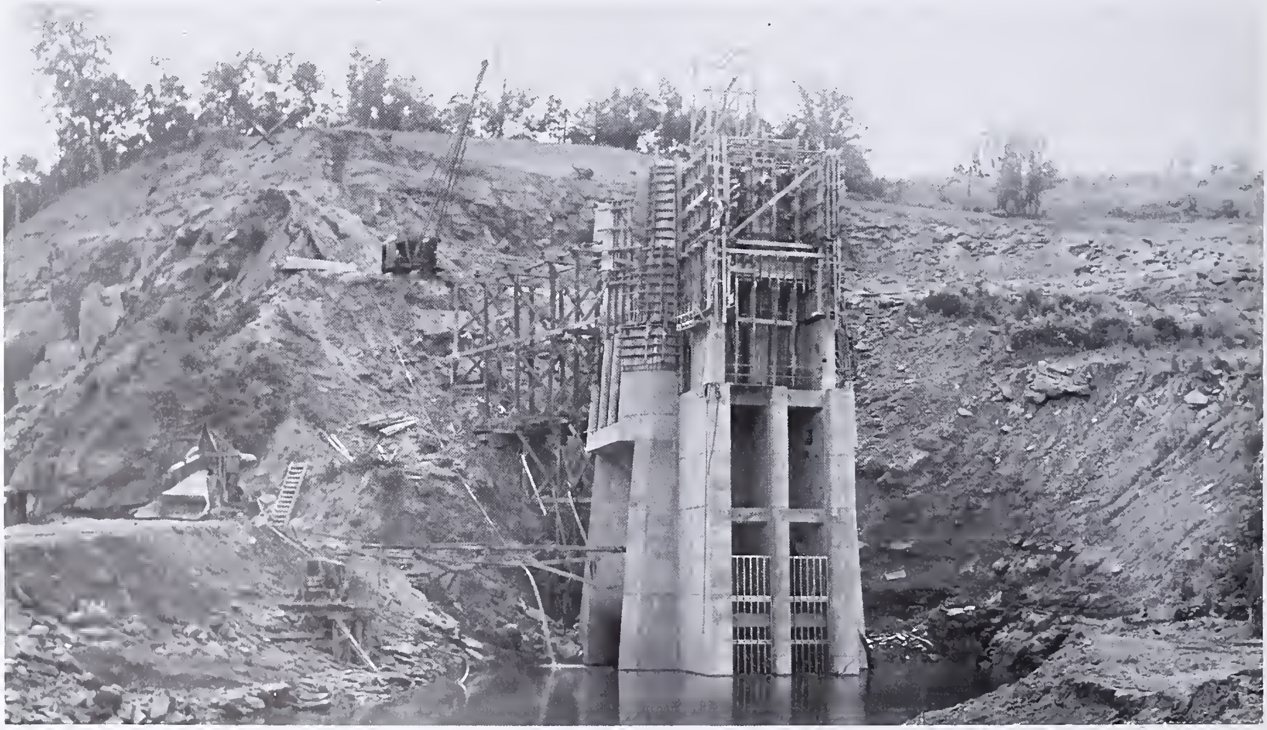
When President Roosevelt announced formation of the Public Works Administration (PWA) in 1933 to assist recovery from the Depression by funding civil works projects and thereby providing employment for thousands, Muskingum basin leaders saw it as an opportunity to gain federal assistance for their proposed flood control and conservation project. They quickly organized the Muskingum Watershed Conservancy District (MWCD) under the Ohio Conservancy Act of 1914, sent a citizens' task force to Washington to meet with PWA officials, and employed C.C. Chambers, formerly with the Miami Conservancy District, as chief engineer.

With the cooperation of the Huntington Engineer District, the MWCD prepared preliminary plans for a broad flood control and conservation program which it submitted to the PWA in August 1933. Cooperative funding was arranged whereby the PWA would contribute $22 million, the state of Ohio would finance highway relocations, and the MWCD would supply up to $12 million from local assessments. The federal contribution to the project was governed by benefits to Ohio River navigation and flood control resulting from the project and the benefits the program would have in assisting regional recovery from the economic Depression.

The MWCD leadership were disturbed when they learned that the federal funds for the project would be spent under direction of the Corps of Engineers. Because of the conservative reputation of the Corps, and its reputed antireservoir position, the MWCD feared the Corps would be unreceptive to the broad multipurpose conservation program, involving reforestation, soil conservation, and public recreation, planned in relation to the flood control program. They found that nothing could be done to keep the Corps out of the program, however, for Corps planners had jumped into the undertaking with vigor in early 1934, anticipating the final agreement between PWA and MWCD by several months.

Because of the unprecedented scope of the project, the Chief of Engineers decided to separate the Muskingum undertaking from the Huntington District and establish an Engineer District at Zanesville. Outstanding Engineers from across the nation assembled at Zanesville in February 1934 to begin District organization, and Colonel Joseph D. Arthur, a native of South Carolina and graduate of the Citadel, West Point, and the Massachusetts Institute of Technology, arrived to become Zanesville District Engineer. Surveys and planning were well underway by March 29, 1934, when the Zanesville District was formally opened.

From February to July, Colonel Arthur supervised an immense survey and planning program: the collection of precipitation and streamflow data, general topographic surveys, and detailed examination of 151 possible reservoir sites. On August 1, 1934, less than six months after the studies were begun, Colonel Arthur presented MWCD with the preliminary draft of the Official Plan for the project. Members of the MWCD were amazed by the fast work of the Engineers, and they were pleased with the unexpected openminded cooperation of the Corps in devising plans fitting into the MWCD program of conservation and other measures to revitalize the region's overall economy. "Officers and technicians assigned to the job showed a remarkable understanding of the over-all program," the MWCD reported. "To the limit of their authority, they accepted the plan, and worked with vigor and success to see that it was carried out."



Construction of the intake structure at Pleasant Hill Dam on Clear Fork in the Muskingum Basin.

Construction of spillway at Mohawk Dam on the Walhonding River. This dam is 115 feet high and was the highest dam ever built on a sand and gravel foundation.

The MWCD accepted the Official Plan, subject to modifications, on October 6, 1934, and the Zanesville District let the first construction contracts in the same month. Colonel Arthur established four area offices, at Dover, Loudonville, Dennison, and Zanesville, to provide local construction supervision. Work was begun at the Tappan and Charles Mill damsites in the first week of 1935, and by the summer of 1935 the other twelve dams, ten railroad relocation jobs, forty-one gasline relocations, and other miscellaneous undertakings were under contract and underway. Less than a year and a half after the beginning of planning in February 1934, all major contract work except one railroad relocation was in progress.

Real estate appraisals, work on land acquisition and flood easements, and right-of-way acquisition converted area courthouses into beehives, and the region as a whole was lifted from the Depression doldrums by the hectic construction activities proceeding simultaneously at the fourteen damsites, the levee sites, and the more than forty relocation sites. Private contractors, who performed construction under Corps supervision, were required to employ as many laborers as possible from relief rolls, because a chief project purpose was to aid in recovery from the Depression. About 58 percent of the funds expended on the project were paid to labor, not including the labor necessary to produce the cement, steel, and other materials that went into the structures.

Colonel Arthur hoped to complete the fourteen dams—one of concrete, the others of earth with concrete outlets—within a three-year construction period. Quick work was required, but it was still imperative that each dam be built safely and economically. Design problems were compounded by the fact that many of the huge earth dams had to be built on silt and clay foundations; indeed, the 115-foot high, earthfill Mohawk Dam, planned as a key installation on the Walhonding River above Coshocton, was the highest dam ever proposed for construction on a sand and gravel foundation.

To deal with foundation and earthfill construction engineering problems, the Muskingum Soils Laboratory, the first of its type, was established at Zanesville in May 1934.

Prior to formation of the Muskingum Soils Lab, engineers had relied on a few elemental rules, and judgment tempered by experience, in building earth levees and dams. Dr. Karl Terzaghi of Austria made the first efforts to apply physics and mechanics to earthwork design just after World War I, and in 1925 he became a professor at Massachusetts Institute of Technology. Colonel Arthur, a graduate of MIT, was familiar with Terzaghi's studies and employed Robert R.

Philippe, one of Terzaghi's students, to direct the Soils Lab. Theodore T. Knappen, a former Corps officer with considerable experience in earth levee construction along the Mississippi River, was appointed Senior Engineer for the Zanesville District, and Glennon Gilboy, professor of soils mechanics at MIT, and Dr. Fred L. Plummer of the Case School of Applied Science were consulting engineers.

At a cost of only $32,000, these scientists and their colleagues in the Soils Lab performed precedent-shattering experiments for the $40 million Muskingum project to determine rational methods for solving foundation problems, producing earth-stabilizing studies with applications far beyond the requirements of the Muskingum project. Soils mechanics studies helped the engineers determine whether soils and earth would be able to withstand water pressure stresses and wave and erosive action, the degree to which soils should be compacted, rolled, and treated to improve impermeability and other qualities, and what soil types would be best for different earth dam sections.

The experiments of Knappen ,Philippe, and their associates at the Zanesville Soils Laboratory removed earth construction from the realm of trial and error and permitted rational planning of earth structures to achieve the greatest safety and economy. Because the Army Engineers were the largest constructor of earthworks in the world, the Soils Lab experiments received worldwide attention from engineers. The Lab's services were extended to many other Engineer Districts and other agencies concerned with earth construction. Similar laboratories were later established by the Corps at many of its major project sites.

Colonel Arthur and the Zanesville District had the fourteen dams and related levee and channel construction nearly completed by 1938, meeting the three-year schedule set up in 1935. The fourteen dams of the Muskingum project were located on three Muskingum River tributary systems. Mohawk Dam was the key control structure on the Walhonding River, with Pleasant Hill, Charles Mill, and Mohicanville dams on tributaries of the Walhonding furnishing additional flood protection. Wills Creek and Senecaville dams were built on Wills Creek and Seneca Fork east of Zanesville. In the Tuscarawas River basin were Bolivar, Atwood, Leesville, Beach City, Tappan, Clendening, Piedmont, and Dover dams.

Thirteen of the dams were earthfill with concrete, gate-controlled outlets, while Dover Dam, on the Tuscarawas, was a concrete-gravity structure. Ten dams created conservation pools for recreation, and four were "detention" type "dry" dams to store floodwaters temporarily, but which did not hold conservation pools.

The dams had sufficient capacity to store a 5.8-inch rain over their respective drainage areas, but some tributaries were left uncontrolled and

Relocated railroad around Beach City Lake.

some areas in the basin unprotected from flood damages because funds available at the time were insufficient to provide full protection. Colonel Arthur later explained: "I conceived my function to be to secure the maximum flood control possible with available funds. I was not directed to prepare plans which provided complete flood control for the Muskingum Valley, and only the best plan for the money was devised."

The proposed Dillon Dam and Reservoir on the Licking River between Zanesville and Newark was not built as part of the original project, Colonel Arthur said, because he and his staff thought the funds could be better spent on the fourteen dams which were built.

Because land acquisition for the project was the responsibility of the MWCD, the Army Engineers were spared the legal tangles and public resentment that commonly accompany the purchase of lands and homes for a public project. Because adequate funding was furnished by the PWA at a swift rate, the Zanesville District was able to concentrate on engineering and construction and complete the project on schedule, without the frequent delays that had so hindered the slackwater navigation projects of an earlier period.

The expert engineers of the Zanesville District easily handled construction and engineering problems, but Colonel Arthur discovered that human problems were less easily overcome. He fought a battle in the national press to counter attacks on the project, as a local pork-barrel, work-relief device, by pointing out that the dams would provide major benefits for Ohio River flood control and navigation. Opponents of the project asserted that, because of unpredictable weather and flood stages, the Muskingum dams could never be operated to reduce the height of Ohio River floods. Colonel Arthur contended that it could be done, if the dams were operated by the Army Engineers.

As originally planned in 1933, operation of the dams was turned over to the MWCD in July 1938,

Dover Dam in the Tuscarawas River Basin, one of the original Muskingum Dams finished in 1938.

Charles Mill Dam and Lake, located on a tributary of the Walhonding River.

but Colonel Arthur fought this step, not in opposition to the MWCD, but because the MWCD would doubtless operate the dams to provide maximum protection for the Muskingum valley, which might not be the best operation for protection of communities along the Ohio River. "If the residents of the Muskingum Valley . . . are taxed for a portion of the costs," he asked, "might they not well ask why they should be interested in what happens at Cincinnati?"

Congressman Robert Secrest of Cambridge, Ohio, brought the issue of Muskingum flood control operations to the floor of Congress in 1939, introducing a bill to turn the Muskingum project operations over to the Huntington District in accordance with national policies for flood control formulated by Congress in 1938. The MWCD was anxious for the Corps to assume the burden of operations, for the MWCD had to tax citizens of the basin to pay operation costs. Congress approved the transfer, making the Muskingum project part of the overall plan for controlling Ohio River floods, and the Huntington District took over operation of the Muskingum system on August 11, 1939.

At completion of construction, Colonel Arthur recommended that the Zanesville Engineer District be closed; and on June 30, 1938, the Muskingum basin was transferred back to the Huntington District, where Colonel Arthur was made District Engineer. An Engineer suboffice at Dover, changed to New Philadelphia in 1940, was established to coordinate operations of the Muskingum dams through a radio network. The "Muskingum Area Office," directed for nearly thirty years by C.E. "Pete" Fulmer and M.A. Laslie, operated the Muskingum dam system with notable success. Within thirty years after completion, the Muskingum flood control project, built at a cost of $40,939,300, had averted flood damages of about $185 million; that is, the system flood control function repaid at least $4.50 in flood losses averted for every dollar invested.

Public recreation on the conservation pools of the Muskingum lakes was an important element of the MWCD program. The reservoirs, with a total water surface at conservation pool level of 16,000 acres, increased the inland water resources of Ohio by 50 percent and brought thousands of people to waterside each year. Because of the land reclamation and reforestation program implemented by the MWCD in cooperation with the Soil Conservation, National Park, and Forest services, the Muskingum project has been described as the "classic example of community, state and federal cooperation in the control of flood waters and the development of natural resources for the public benefit."

While the back door projects at Bluestone in the Kanawha basin and in the Muskingum basin were being launched, cataclysmic events in the Huntington District and the Ohio valley were pushing Congress through the front door to flood control.

March 1936 Flood Prompts First Omnibus Flood Control Act

After a severe Ohio River flood in March 1933, G.W. Mossman and W.S. Rosenheim of the Huntington Chamber of Commerce wrote President Franklin Roosevelt to complain that it was illogical to approve plans for flood control on tributaries like the Muskingum and Kanawha rivers while doing little or nothing to limit direct destruction by floods on the mainstem of the Ohio River. They urged the President to allocate PWA funds for construction of a floodwall at Huntington. In May 1933 representatives of the chambers of commerce of Huntington, Ironton, Portsmouth, Marietta, Parkersburg, and other Ohio River cities met with the Chief of Engineers and other federal officials in Washington to discuss efforts to ameliorate recurrent flood damages; and in June representatives of twenty-five riverside cities organized the Ohio Valley Conservation and Flood Control Congress, with Dr. Charles E. Holzer of Gallipolis as president; Andrew Clooney of Maysville, vice president; E.V. Rawn of Huntington, secretary; Reno Hoag of Marietta, treasurer; and Alan Jordan of Columbus as executive secretary. This organization launched a publicity and lobbying campaign to gain congressional approval for flood control measures along the Ohio, using, when it became available, the ammuniton supplied by the "308 Report" on the Ohio River, completed in 1934.

The Ohio River Division (ORD), successor to the Central Division at Cincinnati, was established in 1933 to coordinate the activities of the five Engineer Districts—Huntington, Pittsburgh, Louisville, Cincinnati, and Nashville—then functioning in the Ohio River basin. In the 1934 "308 Report" on the Ohio River, ORD recommended a flood control program to include thirty-nine reservoirs on Ohio River tributary streams to reduce flood crests, and many local protection projects--mostly floodwalls and levees—for the protection of cities along the main stem of the Ohio. Since Zanesville District was beginning construction of the Muskingum dams in 1934, recommendations on the Muskingum were not included in the 1934 "308 Report." ORD did, however, recommend reservoirs for construction within Huntington District in the Kanawha basin—Clendenin on Elk River, Big Bend on Greenbrier River, and Bluestone on New River. Reservoirs on the Little Kanawha, Hocking, Big Sandy, and Scioto rivers were studied, but not recommended for immediate construction. Floodwall and levee construction was considered for the protection of such cities as Portsmouth, Huntington, and Maysville.

The "308 Report," completed before Congress authorized national flood control, was based on the premise that flood storage reservoirs might be built in cooperation with conservancy districts, like the MWCD, and local protection projects in conjunction with local governments, assisted by funds from Depression work-relief agencies. But local governments were reluctant to impose taxes for floodwalls, and conservancy districts did not exist outside Ohio. The Chief of Engineers reported in 1935 that he had not received a single proposal of cooperation from local interests in constructing reservoirs, and no conservancy districts or other organizations had been established to furnish such cooperation. It appeared in 1935 that Ohio valley flood control might be stymied for years. The record floods that prostrated the Ohio valley in 1936 and 1937 were to alter that situation radically.

Congress was debating the issue of national flood control in 1936 when news arrived of flood catastrophe on the Ohio. Several rainstorms had crossed the Ohio valley into New England in March 1936, causing paralyzing floods that crested five feet above prior records at some points on the upper Ohio and leaving river towns a "sodden mass of wreckage, mud and slime." Telegrams from the stricken cities reached floodtide in Washington, leaving the Offices of Congress, the President, the Secretary of War, and the Chief of Engineers knee deep in pleas for help, and for flood control. Mayor James B. Couch of Point Pleasant, for example, telegraphed:

> WE URGENTLY REQUEST THAT YOU VISIT AT ONCE THE FLOOD STRICKEN AREA IN THE OHIO VALLEY STOP WE DO NOT BELIEVE THE COUNTRY AT LARGE APPRECIATES OR UNDERSTANDS THE ABSOLUTE NECESSITY OF AN IMMEDIATE FLOOD CONTROL PROJECT TO PREVENT DISASTERS IN THE FUTURE SUCH AS HAVE JUST VISITED THE OHIO VALLEY STOP OUR CITY IN A MISERABLE PLIGHT AND HAS SUFFERED IRREPARABLE LOSS AND DESPERATELY IN NEED OF MONEY FOR REHABILITATION PURPOSES STOP THE MOUNTAINOUS STREAMS IN WEST VIRGINIA CAN AND SHOULD BE SO CONTROLLED AS TO PREVENT FUTURE DISASTERS.

The March 1936 flood cost 184 lives and $200 million in property damages in the upper Ohio River basin. Portsmouth, Ohio, was saved, however, by a floodwall built by the city and tieing into a railroad-built levee. This project was prompted by the 1913 flood and completed about 1930. While other Ohio River cities were shut down by the 1936 flood, children shot marbles in the streets of Portsmouth and normal business continued while the river swirled outside the wall. "The Portsmouth floodwall has saved that city several times and repaid its costs many times over, and that is the sort of flood protection we want," leaders of other Ohio River cities told Congress and the President and the Secretary of War and the Chief of Engineers.

Before the 1936 flood had subsided, Dr. Holzer called a meeting of the Ohio Valley Conservation and Flood Control Congress at Huntington, and members of the organization, some in rowboats, traveled to Huntington, where they resolved: "Whereas, the Ohio Valley is now being visited by another flood disaster, which might have been averted to a marked degree by the completion of a comprehensive system of source stream control reservoirs," Congress should immediately act to implement the plans laid out in the Ohio River "308 Report."

Congress responded to pleas for disaster assistance by allotting $43 million for recovery and rehabilitation, and President Roosevelt ordered a quarter million WPA workers into the region to clean up the mess, restore public utilities, and rebuild roads, bridges, and other public property. In addition, the tone of congressional debates over flood control changed after the flood.

Senator Royal S. Copeland asked the Chief of Engineers if he would approve a system of flood control reservoirs for the Ohio River basin. The Chief replied that while the proposed reservoirs were meritorious, "it would appear that their authorization should be considered only in connection with such a general program, the terms of which thereafter may be construed as a basic policy definitive of Federal interest." Senator Copeland, complying with this suggestion, shepherded through committee the first omnibus

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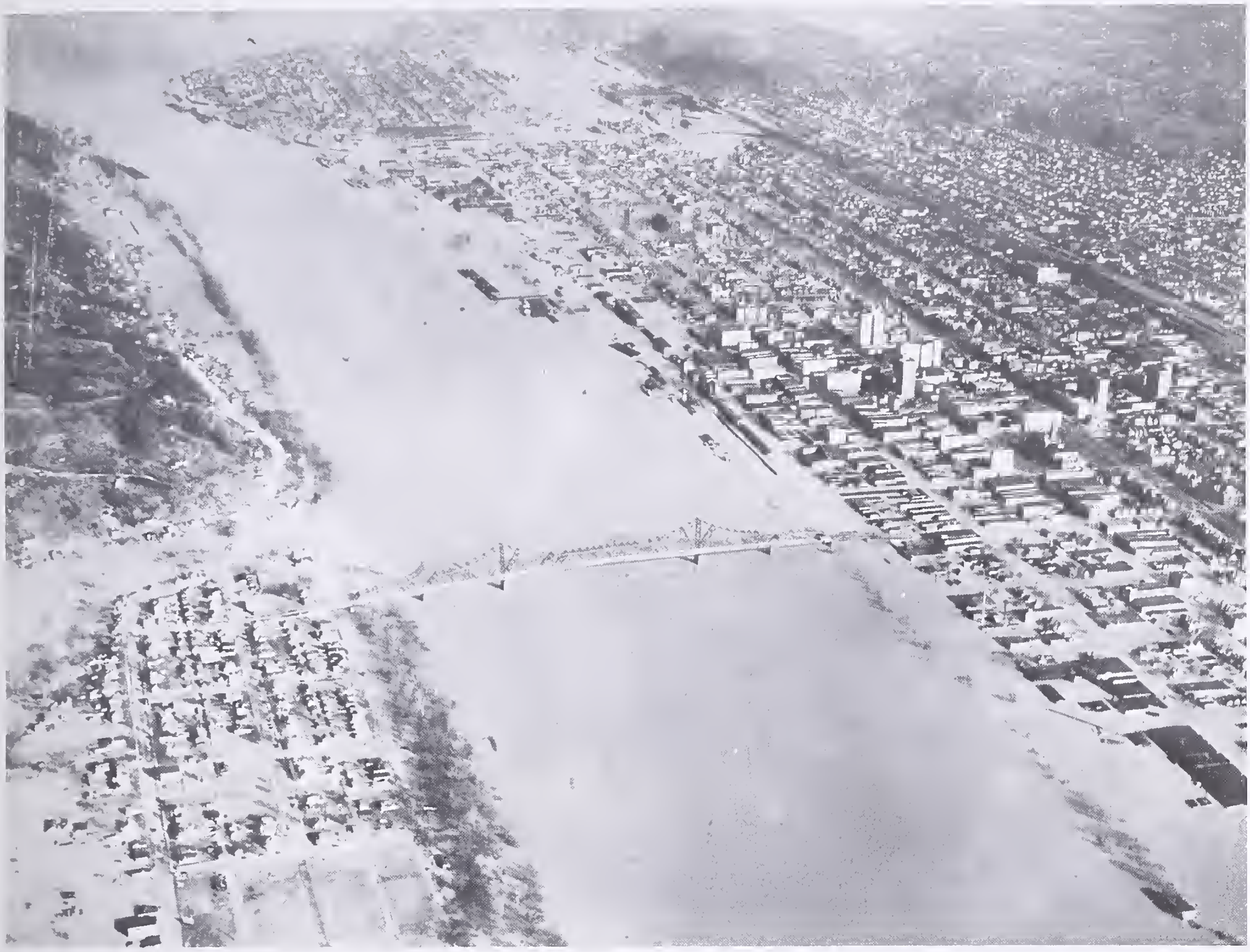
A flood scene in downtown Huntington, West Virginia, on January 25, 1937.



Ohio River, during flood of January 1937 at Huntington, West Virginia.

flood control bill, which dispensed with the hypocrisy of forcing flood control to rest for justification on navigation or employment relief.

The Flood Control Act of June 22, 1936, established a national flood control policy which recognized floods as a menace to national welfare and authorized the Army Engineers to cooperate with state and local governments in building flood protection projects, provided all projects were justified by economic benefits in excess of costs (a favorable b:c ratio).

January 1937 Flood Tops All Records, Leads to 1937 Flood Control Act

As it worked out, no major flood control projects, other than those on the Muskingum, could be completed in the Huntington District before another great flood rampaged downriver in January 1937. A "calamitous inundation of almost biblical proportions" was the way Colonel Paschal Strong of Ohio River Division described it—Colonel Strong had a way with words and was better known as the author of the "Jack Armstrong, All-American Boy" series than as Army Engineer. He was very near the truth, however, in his description of the 1937 flood. Noah's Ark could have been put to good use at Huntington in 1937.

The '36 flood had not reached record crests below Clarington, Ohio, but the '37 flood far exceeded all previous records below Point Pleasant. Rain, averaging ten inches over the entire Ohio River basin, and in some places up to twenty-two inches, fell on saturated ground in January 1937, and runoff was immediate, unleashing a furious and tragic flood that rose to a flow of 654,000 cubic feet per second past Huntington.

The entire Huntington business district was flooded, generally to first floor ceilings; public utility services ended; roads and railroads in and out of the city were blocked; gasoline floating atop the flood caught fire; five lives were lost; and 25,000 people were made homeless. Ironton was almost entirely flooded and suffered two bad fires and two explosions. Catlettsburg was flooded back to the hills, with only the road to Grayson remaining open. Greenup was flooded and isolated, with refugees crowded into second stories, without heat, sanitary facilities, blankets, or adequate clothing.

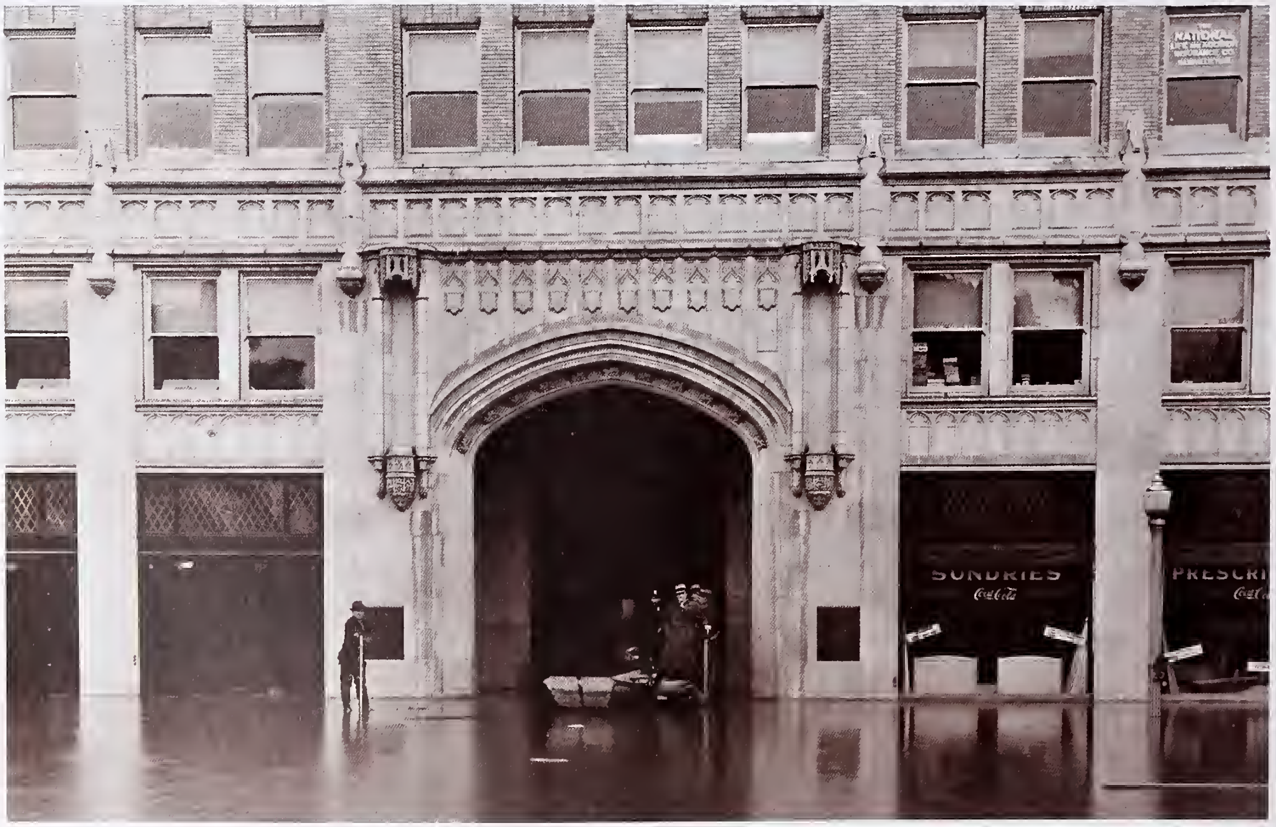
Portsmouth, which had been safe behind its floodwall in 1936, had water ten feet over the top of the floodwall, its downtown area was under fourteen feet of water, and its 27,000 refugees were stranded, with no water, gas, electric, telephone, or hospital services.

Flood damages in the Huntington Engineer District had amounted to about $2.5 million in 1936; the damages were ten times that figure in 1937.

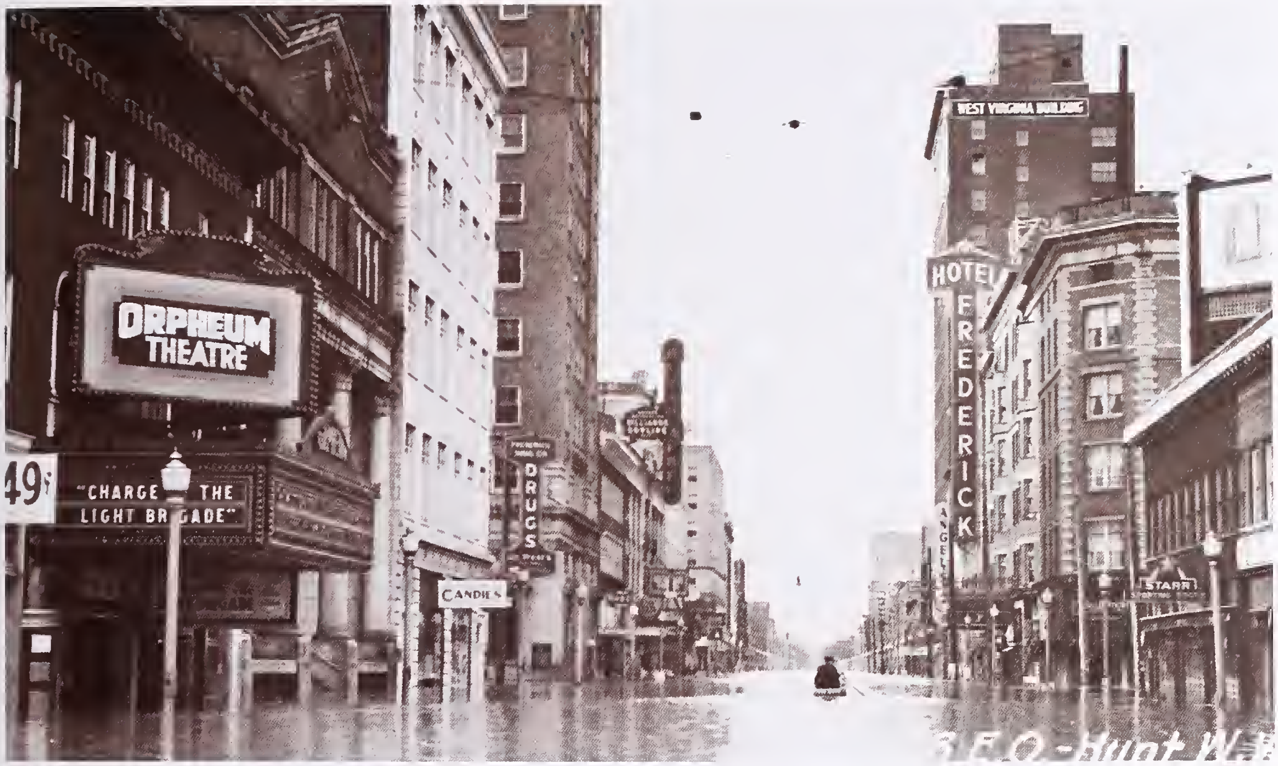
In 1937 the Huntington District office was located in the Coal Exchange (Chesapeake and Ohio) Building, which had nearly five feet of water in its elevator lobby at the crest of the flood. Corps personnel crossed the flood to the building by boat, crawled in through second-story windows, and took their posts. There were no heat, water, or sanitary services in the bulding, but portable equipment was brought in and the District staff stayed on the job during the emergency, some of them on a round-the-clock basis. Because normal communications were disrupted, Huntington radio station WSAZ permitted the District staff to broadcast messages daily to personnel patrolling the river.

Ample relief supplies were available from the Army and Red Cross, and, because severed communications made it difficult to determine the needs of flood victims in scattered communities up- and downriver, Huntington District engineer John F. Conklin and Principal Engineer Harry Pockras created emergency Engineer supply bases at Maysville, Ashland, Point Pleasant, and Marietta, from which daily river patrols operated to determine needs and deliver supplies to flood-isolated towns.

Assistant Engineer John E. Carpenter at the Point Pleasant base hired the steamers *Henry C. Yeiser, Jr.* and *A.C. Ingersoll, Jr.* to supply communities on the West Virginia bank from Hartford to Point Pleasant. J.Y. Neuhard directed supply services from the Engineer fleet base at Marietta; and Dr. Charles E. Holzer, president of Holzer Hospital at Gallipolis as also of the Ohio Valley Conservation and Flood Control Congress, took charge of relief activities on the Ohio bank from Pomeroy to Gallipolis, with the assistance of the Engineer steamer *Iroquois* and launch *Gauley*



Scene shows the entrance to the Chesapeake and Ohio Building, home of the Huntington District, Corps of Engineers, on January 25, 1937.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"CHARGE THE
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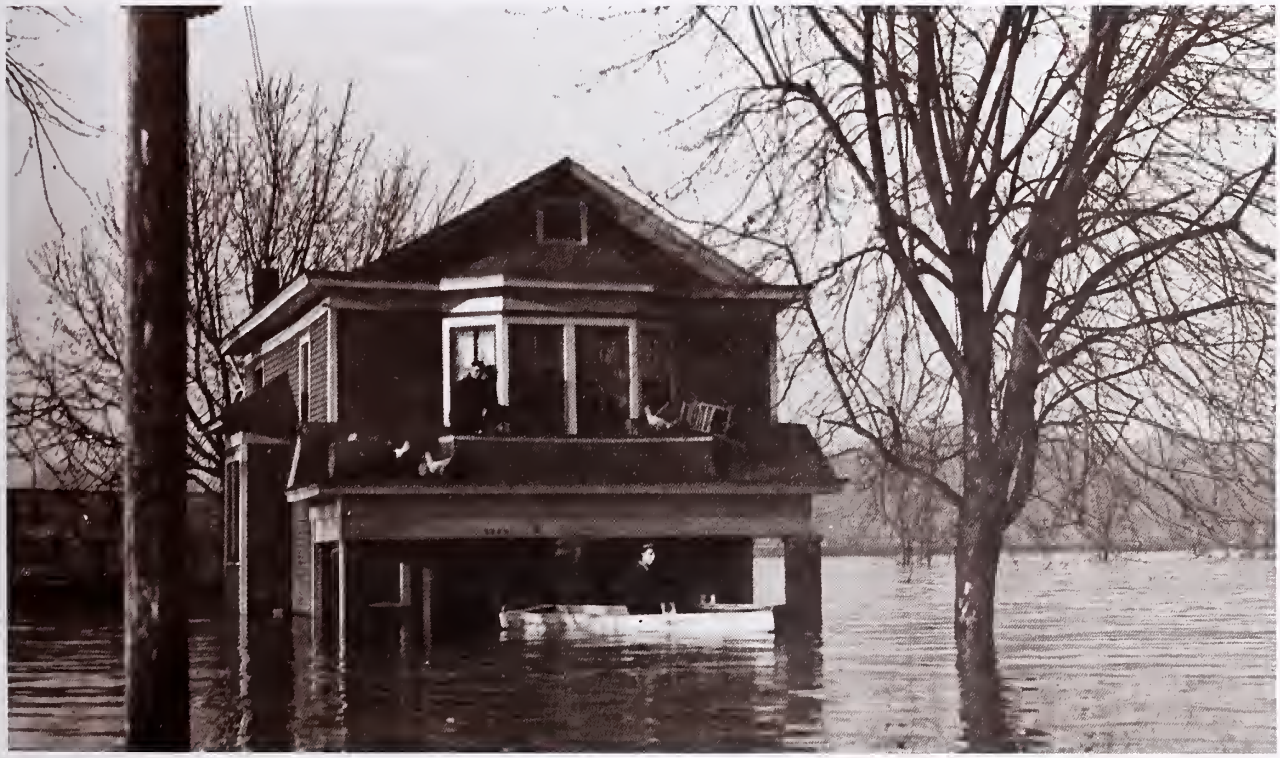
ANGEL
STARR

Downtown Huntington on January 25, 1937, looking west down Fourth Avenue.



A residential area in Huntington on January 29, 1937.

River in distributing supplies.

John Carpenter sent the steamers *Vesta*, *W.C. Mitchell*, and *Henry C. Yeiser, Jr.* to Huntington on January 26, transporting supplies of coal, milk, and survival necessities. It was a harrowing voyage, with the river so high that the boats passed Gallipolis Dam by steaming over the lockwalls, but they made it to Huntington. On January 26 the upper section of Cincinnati District was transferred to Huntington District for the duration of the emergency, and Lieutenant George "Abe" Lincoln, who later became General and director of the national Office of Emergency Preparedness (OEP), was sent from Huntington to the upper Cincinnati Engineer District to perform his first disaster recovery mission. Lieutenant Lincoln, and Assistant Engineers Hubert B. Elder, William C. Steele, Walter Glasgow, and others, organized river patrols and relief supply along the Ohio from Catlettsburg to Maysville, using the Engineer launch *B.F. Thomas*, launch *Burning Springs*, and steamer *Kentucky*, and the chartered boats *Martha*, *Little Fred*, and *Valley Belle*.

Every man and woman in the Huntington and Zanesville Engineer Districts was involved in some way in the emergency and relief activities. Lockmen distributed supplies and evacuated refugees with skiffs and needleflats and provided any assistance possible to flood victims. C.L. Yates and the men at Lock 18 near Marietta and Francis Worthington and the lockforce at No. 23 caught many homes and buildings floating downriver and lashed them to the bank with manila lines and wire cables. Major Frederick F. Frech, assistant to the Huntington District Engineer, went south with N.F. Dortch, Robert W. Wening, and Hubert C. Hodges, to establish a rescue base at Paducah, Ky., on the lower Ohio, and Major French followed the crest of the flood from Paducah on to Memphis and New Orleans. Captain Miles Reber and Lieutenant David McCoach took berths on a train, loaded a current meter in one berth, and proceeded to the Ohio River Division office to assist in the emergency there—Captain Reber later was selected as the head of the Flood Control Division at the Office of the Chief of Engineers.

U.S.E.O. Hunt. W. Va.
Jan. 29
Huntington, W. Va.
13

A scene in Huntington's westend on January 29, 1937, showing chickens taking refuge on the roof of the porch and a rocking chair teetering precariously atop the chimney.

At the height of the flood and hectic emergency operations, Chief of Engineers Edward Markham telegraphed the Ohio Valley Engineer districts:

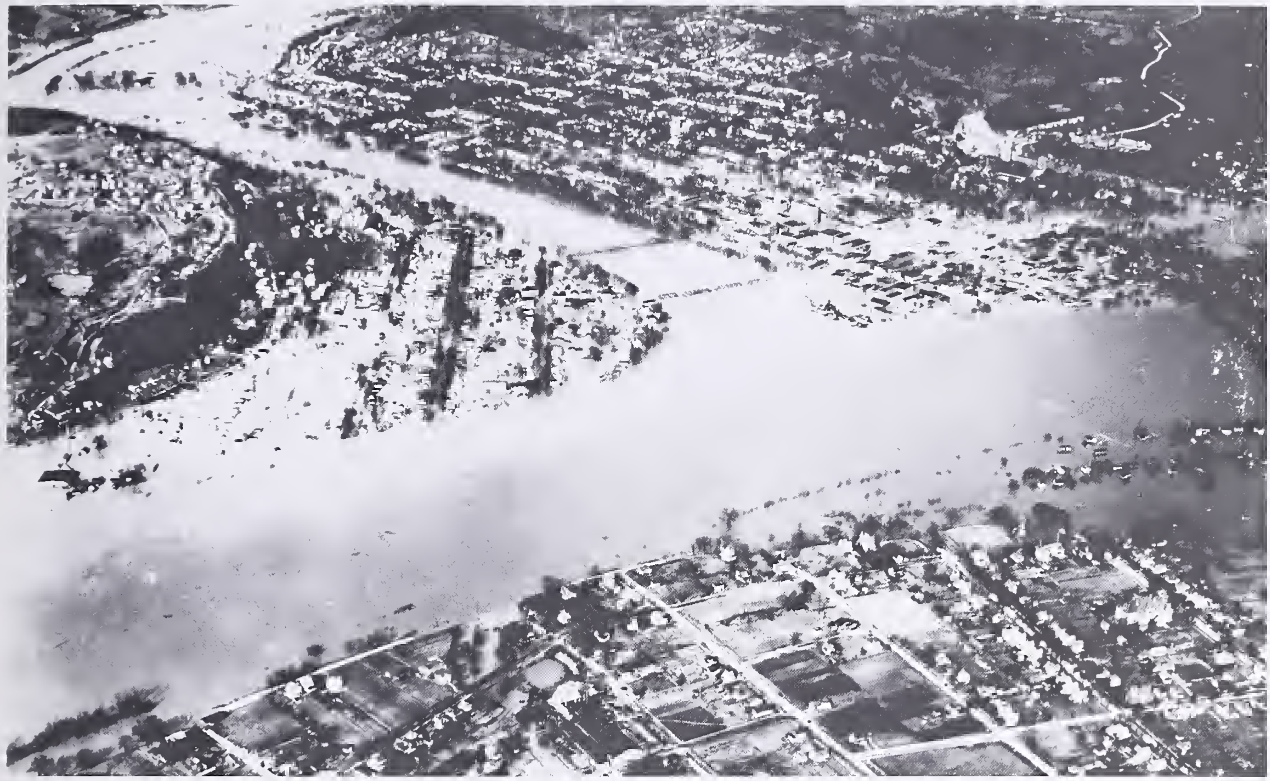
> IT IS DESIRED THAT YOU TAKE CARE TO OBTAIN FULL DETAILED RECORDS OF THIS FLOOD IN THE OHIO BASIN WITH A VIEW TO REVISING AND BRINGING UP TO DATE FOR THE DEPARTMENT WITHOUT DELAY A COMPLETE FLOOD CONTROL PLAN FOR THE BASIN INCLUDING ADEQUATE PROTECTION FOR ALL CITIES AND TOWNS.

Those instructions were superfluous, for the Huntington District already had as many men as possible out on the rivers collecting rainfall data, measuring flood discharges, and photographing the flood. A complete aerial photographic survey was also in progress. The Engineers were especially interested in the effects the proposed flood control reservoirs might have had on this "superflood." They learned the partially completed dams on the Muskingum reduced the flood crest at Zanesville by four feet and at Marietta by three feet, despite the fact that the unfinished dams could only operate at about 20 percent efficiency. The '37 flood actually crested on the Muskingum about a foot below the point where all business and industry would have been shut down, and the inches lopped off the crest by the unfinished dams did much to hold flood damages in the Muskingum basin to about $2 million.

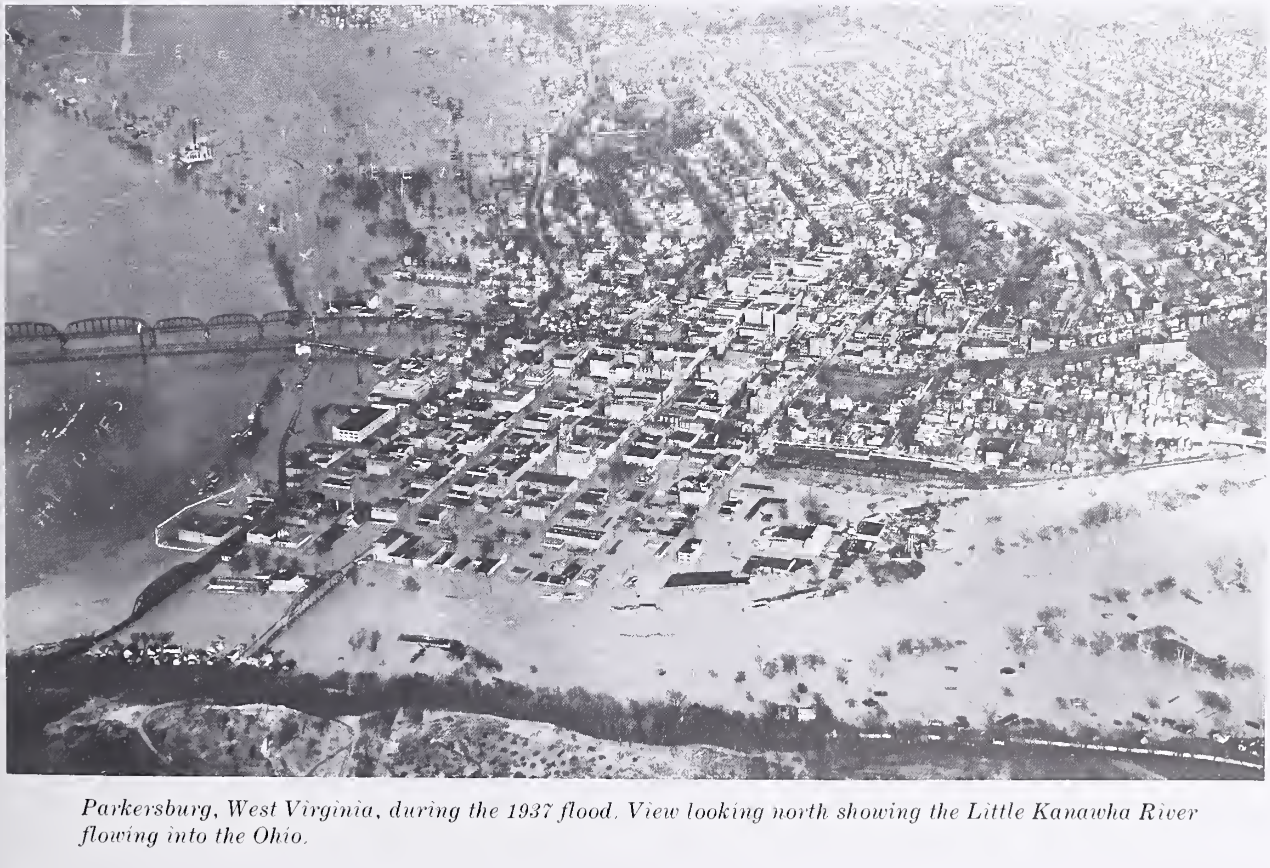
On February 10, even before the flood had reached the Gulf of Mexico, the House Committee on Flood Control directed the Chief of Engineers to submit revised flood control plans to prevent repetition of flood losses as huge as those of 1937, for Congress and the Executive offices were again experiencing a paper flood of messages, like that sent by the Portsmouth Rotary Club, which urged quick construction of flood control projects because:

> Portsmouth in company with all the cities and countrysides contiguous thereto and comprising the Ohio Valley watershed has suffered a terrific property loss, accompanied by intense suffering and death on the part of the people living therein, as a result of the recent unprecedented flood stage of the Ohio and its tributaries.

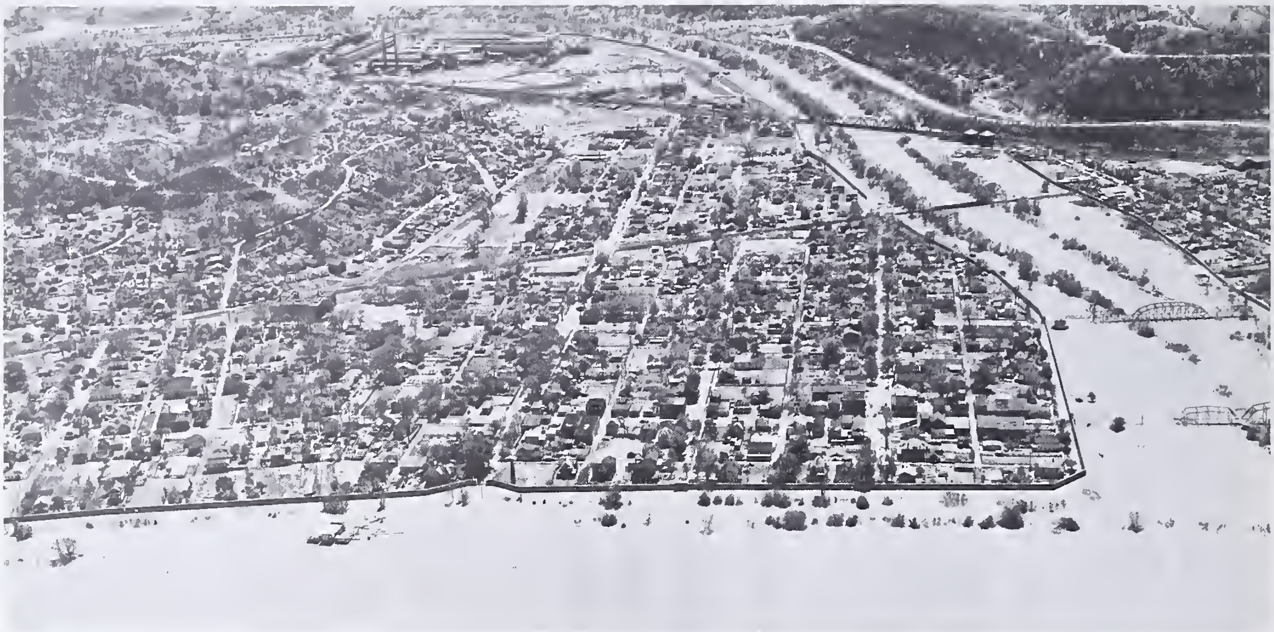
Hundreds of telegrams and letters suggested possible methods to control floods and offered support for flood control projects. The National Negro Congress asserted that over half the flood victims were black and urged that "neither money nor governmental machinery be spared to carry



Flood of January 1937 at the confluence of the Ohio and Muskingum Rivers, showing the city of Marietta, Ohio at top and the town of Williamstown, West Virginia, in foreground.



Parkersburg, West Virginia, during the 1937 flood. View looking north showing the Little Kanawha River flowing into the Ohio.



Guyandotte, in east Huntington, behind its protective floodwall in the mid-fifties. The International Nickle Company is the complex at the top of the picture.

through a comprehensive program both for controlling these recurring calamitous floods, and for preventing their occurrence." One citizen urged President Roosevelt to end the work of the Civilian Conservation Corps, because the young men of the CCC were clearing brush and straightening creeks, thereby increasing the rate of runoff, with resulting flood havoc. The President also received an enigmatic telegram reading: HAVE THE OHIO FLOOD PROBLEM SOLVED STOP WILL WRITE YOU STOP WILL START ON THE MISSISSIPPI PROBLEM NEXT WEEK. Unfortunately, the promised letter was never received.

Within sixty days after the flood emergency ended, the Huntington District and the other Districts on the Ohio had revised plans ready, and, because the '37 flood had approached the maximum flood thought possible, the revised plans proposed swift construction of forty-five more reservoirs, in addition to those authorized in 1936. In the Huntington District, four reservoirs on the Little Kanawha, one on the Hocking, three on the Big Sandy, and five on the Scioto River were recommended, plus the construction of levees, floodwalls, and drainage structures to protect urban areas.

In dramatic testimony before the House Committee on Flood Control, General Markham, Chief of Engineers, reviewed the 1937 flood disaster, using photographs of the flood at Huntington to illustrate the situation graphically. He told the committee that Huntington had been flooded twenty-three times in fifty-five years, and that the 1937 flood had inundated the business section to an average depth of eleven feet, killed five people, forced 25,000 residents from their homes, and caused losses estimated at over $14 million. Flood losses in the entire Ohio River basin had exceeded $200 million in 1936 and $400 million in 1937. General Markham concluded that, while each flood control project would be economically justified by comparing benefits with costs (b:c ratio), it was his opinion that the real justification lay in "the saving of human life and suffering, and in the prevention of the disturbance of the affairs of the Nation brought about by a flood disaster."

The Chief was followed by Huntington City Engineer John S. Gillespie, W.S. Rosenheim of the Huntington Chamber of Commerce, and Colonel J.H. Long, Huntington newspaper publisher, who each confirmed the testimony of the Chief of Engineers and declared that 95 percent of the people of Huntington wanted a floodwall built quickly.

The construction of local flood protection projects at cities selected by the Chief of Engineers was authorized in the 1937 Flood Control Act, and on November 20, 1937, President Roosevelt ordered the Secretary of War to submit a list of local protection projects which could be swiftly completed, would employ the maximum number of relief laborers, and would provide the greatest amount of protection for the funds invested. A floodwall and levee system for Huntington was selected as the most eligible project for immediate construction in West Virginia.

Some towns along the Ohio River hesitated, because federal construction of local flood protection projects required the local governments to cooperate by voting taxes and bond issues to purchase necessary land and rights-of-way for construction and to fund operation and maintenance of the floodwalls and levees after completion; they hoped Congress would approve full federal funding. This was certainly not true in Huntington, where mass meetings were held in support of the floodwall and businessmen voluntarily contributed funds and pledged further support.

Congressman George W. Johnson told the House Flood Control Committee that Huntington was "eternally and everlastingly, every year" suffering flood damages far above the costs of local cooperation and was ready and willing to contribute its share. He pointed out that the Huntington floodwall and levee would be built in three sections—Huntington (No. 2); Westmoreland (No. 1); and Guyandotte (No. 3)—over a period of years. W.S. Rosenheim asserted that in event of war the Huntington floodwall could be vital, for the Guyandotte section would protect the International Nickel Company, which had been put out of operation for six weeks by the ten feet of water that flooded it in 1937. Because the International Nickel Company was the only plant in the United States producing the nickel vital for American munitions and ordnance, Rosenheim declared: "The closing of this plant in times when the country might be at war during urgent demands for munitions of the kind being made, the closing of this plant as it was closed down in 1937 for a period of 6 weeks, would mean the supply of nickel would be seriously curtailed." The Huntington City Council gave assurance on March 14, 1938, that it would meet requirements for local cooperation and issued bonds in 1938, 1939, and 1941 to pay for the three sections of the project.

In a series of meetings in late 1937 and early 1938, Principal Engineer Harry Pockras of Huntington District, Sam Bailey of Louisville District, Senior Engineer William H. McAlpine of the Office of the Chief of Engineers, and other members of District Engineering staffs met to hammer out details and establish standards for Ohio River floodwalls and

Construction scene of the Huntington floodwall.

levees. The Engineers decided to build all floodwalls and levees to a height three feet higher than the highest flood of record, so as to provide for a somewhat greater flood and allow for wave action. Cantilever steel walls encased in concrete were selected as standard floodwall design, and it was determined that levees should have a minimum eight-foot top width and side slopes of from 1 on 2 to 1 on 3. Because of differing hydrographic and topographic conditions, the floodwalls and levees could differ in certain respects, but all would conform to the standards agreed upon.

Construction of the Huntington floodwall, the first in the Huntington Engineer District, was begun on August 1, 1938. The Cincinnati Engineer District began construction of the local protection project at Ironton at about the same time. Because Section II, protecting the central business district at Huntington, was the first built, the first gate opening completed in the wall was used for experiments to determine the best type of gates for use in Ohio River Division floodwalls. Huntington Section II comprised 17,900 feet of concrete floodwall, taking in a section along the Ohio River from Highlawn, an above-flood area just below the mouth of the Guyandotte, to a point near Third Street West, where the wall joined the levee of Section I. The wall had twenty-four gate openings for use of highway and railroad traffic, seven pumping stations to dispose of water accumulating behind the wall during floods, and storage houses for the gates, which were to be installed in the gate openings only when the river was at flood stage. When Section II was completed in 1940, construction of Section I (Westmoreland) was begun. The building of Section III (Guyandotte) was scheduled to begin in 1941.

The adjoining towns of Ceredo and Kenova, six miles below Huntington at the mouth of the Big Sandy, also had a long history of flood disasters, and after the 1936 flood Kenova passed a bond issue to match WPA funds to build a floodwall to protect against a river stage of 60.7 feet. Mayor John T. Hereford of Kenova told the House Flood committee in 1937 that the '37 flood crest of over 69 feet had covered most of Kenova and contiguous Ceredo, had driven 60 percent of the townspeople from their homes, had floated homes from foundations and ruptured gas and water mains, and had damaged property valued at $2,700,000 in the two communities. The towns therefore wanted a floodwall to provide protection against a 72-foot stage.

Congress approved projects to protect Ceredo and Kenova in 1937, and in March 1938 the two towns, with funds donated by citizens and money derived from bond issues, assured the Corps of Engineers that they would cooperate. To avoid building a wall between the two towns, the Huntington District combined the two projects. Construction of the Kenova unit—6,300 feet of earth levee and 3,600 feet of concrete floodwall—was begun in 1939 and was completed late in the year. The Ceredo unit—6,200 feet of levee and 5,400 feet of concrete floodwall—was completed in 1940.

In addition to the two Ohio River projects, the Huntington District also began the construction of two local flood protection projects in the Muskingum basin; at Newark on the Licking River and Massillon on the Tuscarawas, in 1939 and 1940. These were the first "channelization," or channel rectification projects in the District. The Newark project consisted of dredging wider and deeper channels for Raccoon Creek and the North and South forks of Licking River, plus construction of a levee and pumping station on the left bank of South Fork, to pass floods as much as 20 percent greater than the record flood of 1913. The Newark City Council accepted responsibility for local cooperation on February 6, 1939, and by November 18, 1941, the Huntington District had the project completed.

A project to dredge the Tuscarawas River at Massillon had been included in the MCWD plans, but had been omitted in 1937 when Congress approved local flood protection projects for the Ohio River basin. The Massillon Conservancy District was organized to cover local costs, and it gained approval from Congress in 1939 for a project to improve the flood-carrying capacity of the Tuscarawas and relocate railroad lines and bridges along the riverfront. The Huntington District began dredging out the Tuscarawas at Massillon in 1940, but was unable to complete the work before the military construction requirements of global war slowed or stopped most civil works construction throughout the nation.

Pearl Harbor Halts Flood Control Efforts

As Japanese bombers zeroed in on the battleships at Pearl Harbor, on that lazy Sunday in December 1941, high water and rain had ended most active construction in the Huntington District for the season, and the Engineers had begun catching up with their paperwork before the Christmas holidays. Civil works plans were radically altered by the military emergency, as the Engineers launched the most massive military construction program in American history.

At the onset of war, the Huntington District was engaged in a vast planning program for flood control reservoirs and local flood protection projects throughout the District and had just awarded the contract for construction of Bluestone Dam. But flood control work came nearly to a halt in 1942. Only the Huntington and Ceredo-Kenova floodwalls and the Newark channel rectification projects were completed when the war began, but these few projects nearly paid for themselves during the war, and the floodwall at Huntington may have shortened the war and altered the course of history.

Chapter XI

Two World Wars, and Civil Works Undertakings

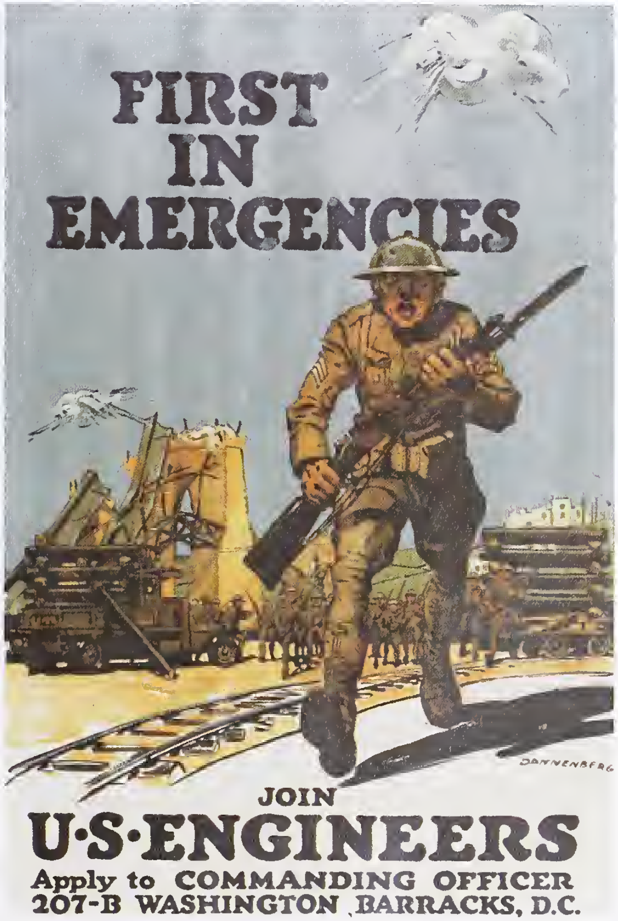
When the United States entered the Second World War, the Corps of Engineers and the Huntington District were in the throes of a major reorganization, for on December 1, 1941, President Roosevelt had ordered the Construction Division of the Quartermaster Corps merged with the Corps of Engineers by December 15. This massive consolidation, accomplished during the Pearl Harbor emergency, brought the civil works construction skills of the Huntington and other Engineer districts into the forefront of the national mobilization for global war against the Axis Powers.

Military construction in support of the armed forces had been since the days of Colonel Richard Gridley and Colonel Rufus Putnam, a major mission of the Army Engineers, until, after the Civil War, the military construction mission was divided. The Corps of Engineers then continued to handle overseas and combat construction and the building of coastal fortifications, while the Quartermaster Corps was given the responsibility of building camps, hospitals, ordnance plants, depots, and other Army facilities within the continental United States. From 1865 to 1940, the Army Engineers in the heartland Ohio valley region limited their building to civil works projects for navigation and flood control, while the Quartermaster Corps built structures needed for the Army.

The Corps in World War I

George W. Goethals, who had been assistant to Colonel William E. Merrill on the Ohio River project and later built the Panama Canal, became acting Quartermaster General of the Army in 1917, and he insisted that construction, whether overseas or in the United States, should be handled by the Army Engineers, to free the Quartermaster Corps to deal with logistical problems. But because of "interdepartmental politics," the transfer of construction functions to the Engineers was not actually made in 1917. Instead, an independent Construction Divison was established to carry out Army construction in the continental United States. On the other hand, the Army Engineers were the first American troops to enter combat and suffer casualties in France, and in France the Engineers completed a massive program of railroad, harbor, and fortification construction. But the Engineer civil works organization was not mobilized for military construction on the homefront during the First World War.

World War I thus made little direct change in the daily operations of the Wheeling and Cincinnati Engineer Districts, predecessors of the Huntington District. Nevertheless, the services of Engineer officers were required in France, and many Districts had during that period their first and only civilian District Engineers; Benjamin F. Thomas, for example, was District Engineer of the Second Cincinnati District in 1917 and 1919. Normal civil works operations were hampered, too, by the large number of Engineer personnel who joined Corps combat units or the Construction Divison. Partici-



pation in the war by personnel of the Districts who remained at their civil works posts in 1917 was, however, actually very limited.

Assistant Engineer Thomas E. Jeffries, in charge of the Charleston suboffice on the Kanawha, devoted most of his attention, perforce, to keeping the Kanawha locks and dams in operation to move coal and other vital materials to supply war industry. He was concerned, however, by accounts of German Zeppelin bombing attacks on London, and he told his old friend William M. Black, Chief of Engineers, that he was familiar with experiments made with communications through light beams and asked if it would be possible to electrify the light rays from a searchlight to set the German Zeppelins afire. "If this idea is worth anything," Jeffries said, "give it to someone who can work it out, as I cannot, being too old to do anything, but eat less, think more, and hope for the best." General Black told Jeffries the idea of using a sort of "laser beam" to bring down the Zeppelins was not practicable, because the ballooncraft usually did not come near enough to searchlights for the rays to be effective.

Minor efforts were made of course by civil works personnel to contribute something to the defeat of the "Hun." In 1918, for instance, the Wheeling District Engineer asked all personnel to collect peach pits and nutshells for use in gas masks, declaring: "Only the best Gas Masks will save our Boys from Hun frightfulness, and one of the necessary parts of this program is the very highest grade charcoal . . . . *Will you do this to help the boys in France?*"

The independent Construction Division at the Quartermaster Corps, built scores of bases, airfields, ordnance plants, and depots throughout the nation in 1917 and 1918, and several installations were built in the Ohio River drainage basin. The Army Service Forces Depot at Columbus, Ohio, for example, was built by Major T. Frank Quilty, QMC, in 1918 as a war emergency project. Major Quilty planned standard wooden barracks and concrete-brick warehouses, served by a rail line and a "high class wagon road," and built the depot with 4,000 men, 200 light artillery horses, and forty two-ton trucks. When his labor went out on strike, Major Quilty brought the strike to an end by prominently displaying patriotic posters, making patriotic speeches, and, in one instance, reminding the laborers of a man called Judas who sold his Master for thirty pieces of silver and asking the workers

1918
S. ENGINEERS

Corps of Engineers truck, used in the Wheeling District 1918.

what they were doing to their country. This ploy worked and the men returned to their jobs, but when new construction jobs opened in the area the workers at Columbus Depot deserted almost en masse. The Major finished the project only with the assistance of the city of Columbus, which enacted an ordinance making it a crime for men between sixteen and sixty to be unemployed—men violating the ordinance received suspended sentences, provided they reported to Major Quilty at Columbus Depot.

Though the Construction Division took care of military construction, the Corps of Engineers civil works districts did make an important indirect contribution to the 1917 war effort by keeping up the Ohio River locks and dams to assure deep slackwater for boats moving materials for war industry.

Because railroads were overburdened by the immense quantities of military supplies on the way to Eastern seaports for transport to combat theaters, Colonel Lansing H. Beach, Central Division Engineer, ordered Engineer districts in the Ohio basin to locate and bring into service any idle boats "to establish a system of freight movement upon the Ohio to relieve the congestion upon the railroads." Old boats were located, repaired, and recommissioned for service in the emergency. In addition, the Charles Ward Engineering Works on the Kanawha, the Marietta Manufacturing Company at Point Pleasant, and other Ohio River boatbuilders constructed a huge aggregate tonnage of new boats and barges. And Ohio River commerce, which had reached a low ebb with the end of long-distance coal shipments to New Orleans in 1916, revived during the war and began a steady upward climb.

Lansing H. Beach, who became a General and Chief of Engineers at the end of the First World War, summarized in these words the lessons of the war as they related to waterways in his official report for 1920:

> The interest of the Federal Government in the construction of comprehensive road and interior waterway systems throughout the United States . . . is far greater as a measure of defense than for commercial reasons, great as is the necessity of these for the latter purposes. This statement is made advisedly, for the preservation of the life of the Nation is the central government's greatest responsibility in peace and in war, and hence every facility should be developed to allow a successful defense to be made. It fortunately happens that roads and waterways constructed solely to meet the needs of commerce are generally well adapted to the needs of defense, and the immediate interests of the people can be counted on to secure support for this great preparedness measure.

Peacetime Organizational Shifts

The independent Construction Division was again merged with the Quartermaster Corps in 1920, and it remained responsible for military construction in the Ohio valley region during the interim between World Wars, while the Corps of Engineers concentrated on completing the Ohio River slackwater system of navigation and developing flood control plans.

In October and November 1940, however, after World War II had begun in deadly ernest with the German blitzkrieg, the Corps of Engineers was assigned the mission of building airfields for the Civil Aeronautics Administration and the Army Air Force, thus launching a huge airfield construction program and also extending an old Corps innovation. Colonel John N. Macomb, who built an Engineer snagboat fleet at Cincinnati in 1866, had also built the first aircraft facilities for the Army air force—balloon launching installations for the Union Army Balloon Corps during the Civil War—and General Mason M. Patrick, a Corps officer who had served on the Muskingum River project with William E. Merrill and Lansing H. Beach, had been appointed first Chief of the Army Air Force in 1921.

To take advantage of the decentralized Corps of Engineers civil works organization—eleven Division and fifty District offices across the United States in 1941—President Roosevelt approved transfer of the Quartermaster Corps Construction Division to the Corps of Engineers on December 1, 1941, directing that the merger be completed by December 15. This amalgamation, accomplished largely by absorbing the experienced Quartermaster Corps engineers into the Corps of Engineers, was given added urgency by the bombing of Pearl Harbor on December 7, which made swift mobilization of the armed forces imperative.

District's Military Mission in World War II

At the onset of the war, the Huntington Engineers were building scattered local flood protection projects, beginning construction of Bluestone Dam and Reservoir on New River, and planning many other flood control projects. This was ordinarily slow, deliberate work, with economy, safety, and durability the primary considerations. In a fortnight, the District was thrust into a nearly overwhelming military construction program, requiring hundreds of site surveys, swift assembly of available contractors and construction equipment, and urgent construction to meet sixty-, ninety-, and hundred-day deadlines, with the chief criteria being speed of construction and serviceability. Cantonments had to be built to house and train the thousands of recruits and draftees swelling the ranks of the Army; airfields had to be opened to train pilots, aircraft crews and mechanics; munitions and ordnance plants had to be built to supply the troops with the tools of war; and hospitals had to be erected to care for the wounded.

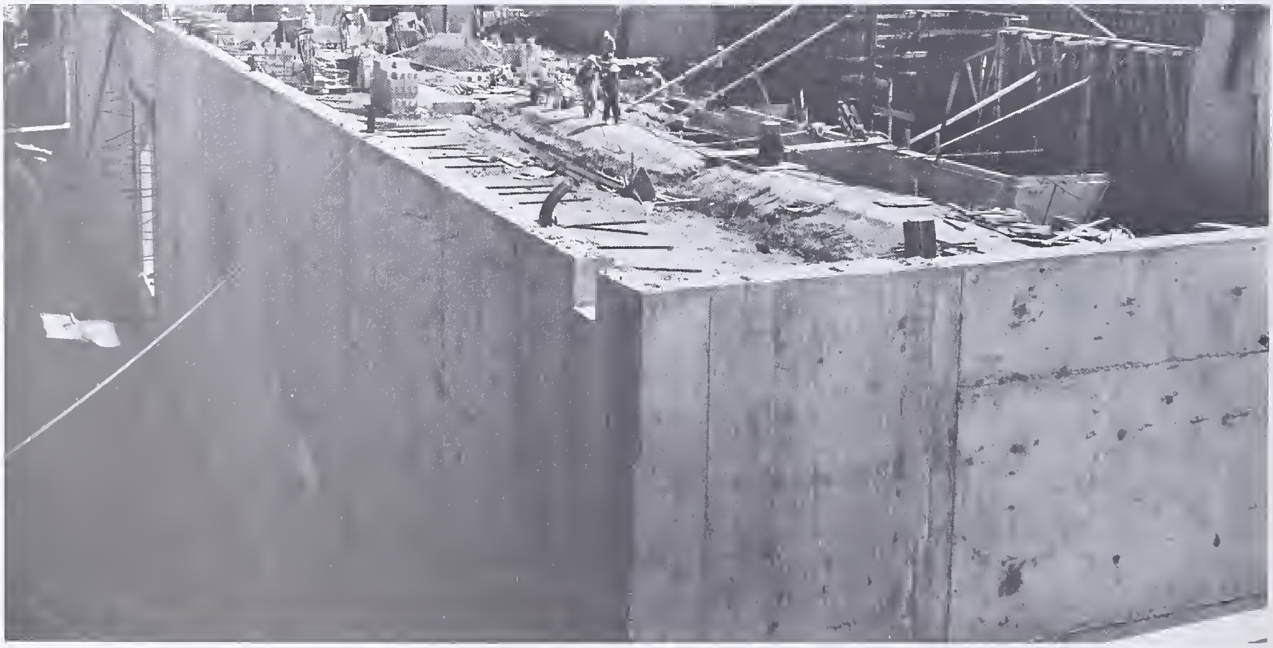
Huntington District personnel had no holiday on New Year's Day, January 1, 1942, nor any other holiday thereafter for the duration of the war. Civil works projects had been leisurely built under very deliberate authorization, planning, and accounting procedures; wartime military projects were often authorized by a phone call from Washington, constructed by oral contract with architect-engineering firms and building contractors, and frequently completed long before the paperwork caught up with the men who built them.

Colonel Joseph D. Arthur, just before his transfer from Huntington District in 1940, had ended the old District administrative system whereby the Prncipal Engineer and the Chief Clerk had personally directed and often dominated most work in the District. Colonel Arthur established a depersonalized corporate-type organization, with functions divided among Administrative, Engineering, Inspection, and Operations divisions, each with specialized subbranches.

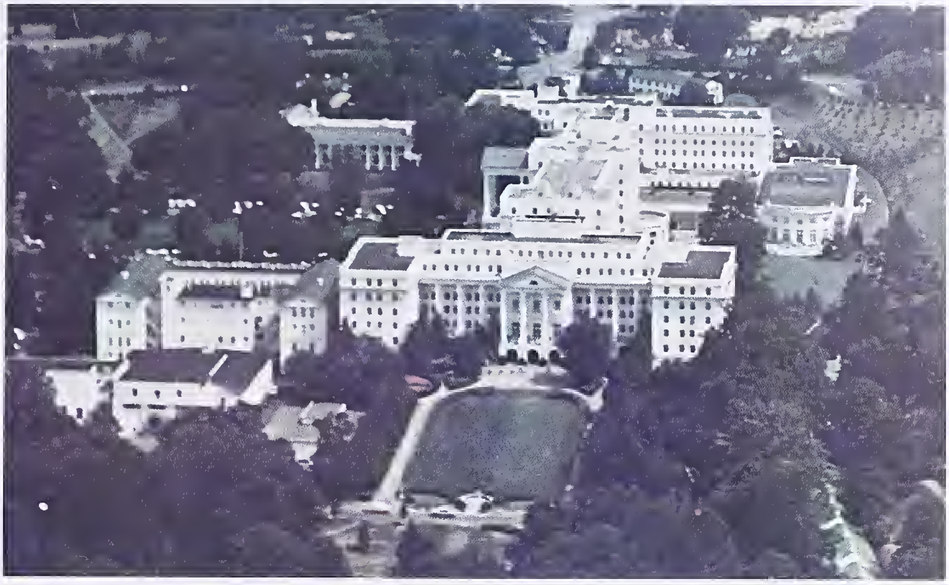
To deal with the burgeoning emergency military mission, District Engineer Francis H. Falkner on December 29, 1941 created the Military Section of the Engineering Division under Chief Conrad M. Ross, and also established a Military Control Section in the Administrative Division with Guy O. Barrett as chief of section, and a Guard Section, under Chief Matthew W. Kinner, to handle security matters.

Led successively by Colonel Falkner, Colonel Wilson B. Higgins, and Lt. Colonel Harry Pockras, former senior engineer in the District, who accepted a Corps commission and was appointed District Engineer in mid-1943, the military construction organization effectively met the challenge of hectic, nearly frantic, construction schedules, pursued under ruthless pressures from Washington for on-time completion with minimum use of critical materials—and nearly everything needed for construction had a critical classification.

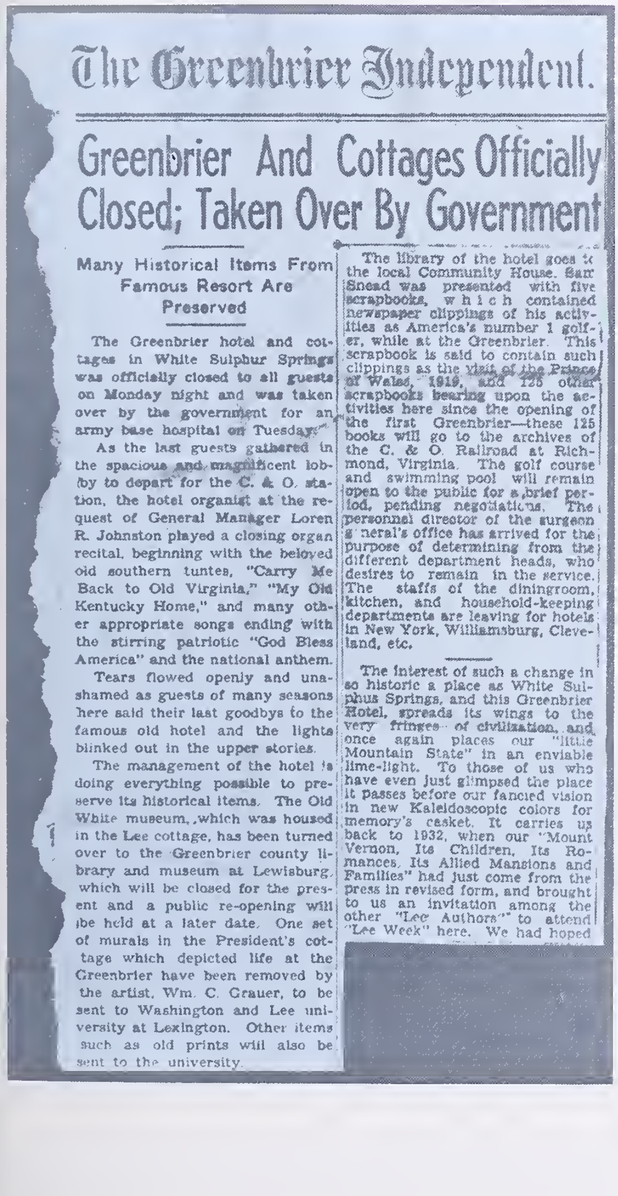
The Huntington Engineers were also rushing construction of several airports and airbases to train the airmen who were to bomb Axis cities to rubble. The largest of these was Lockbourne Air Force Base near Columbus, where the Engineers began razing farm houses and dozing out runways in January 1942, and had the first airstrip ready for planes on June 4, twenty-six days ahead of schedule. At Lockbourne, the Corps reaped important benefits from the soil and concrete experiments performed at the Zanesville laboratories on the Muskingum River project. Robert R. Philippe, former director of the Zanesville Lab, built experimental runways at Lockbourne that were vital in the design of economical runways that could withstand the impact of heavy aircraft. Lockbourne first served as a Glider Pilot Training School, with singleseat gliders towed by L-5 aircraft, and CG-4 type gliders towed by C-47 aircraft.



Lockbourne Air Force Base in the 1950's showing continued construction after World War II.



Historical Greenbrier Hotel at White Sulphur Springs, West Virginia. This hotel was bought by the Army on September 1, 1942, and converted into a hospital and prisoner-of-war camp by the Corps of Engineers.



The Greenbrier Independent.

Greenbrier And Cottages Officially Closed; Taken Over By Government

Many Historical Items From Famous Resort Are Preserved

The Greenbrier hotel and cottages in White Sulphur Springs was officially closed to all guests on Monday night and was taken over by the government for an army base hospital on Tuesday.

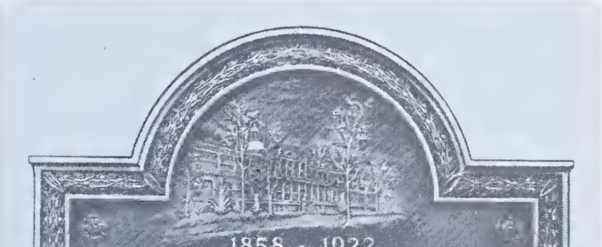
As the last guests gathered in the spacious and magnificent lobby to depart for the C. & O. station, the hotel organist at the request of General Manager Loren R. Johnston played a closing organ recital, beginning with the beloved old southern tuntes, "Carry Me Back to Old Virginia," "My Old Kentucky Home," and many other appropriate songs ending with the stirring patriotic "God Bless America" and the national anthem.

Tears flowed openly and unashamed as guests of many seasons here said their last goodbys to the famous old hotel and the lights blinked out in the upper stories.

The management of the hotel is doing everything possible to preserve its historical items. The Old White museum, which was housed in the Lee cottage, has been turned over to the Greenbrier county library and museum at Lewisburg, which will be closed for the present and a public re-opening will be held at a later date. One set of murals in the President's cottage which depicted life at the Greenbrier have been removed by the artist, Wm. C. Grauer, to be sent to Washington and Lee university at Lexington. Other items such as old prints will also be sent to the university.

The library of the hotel goes to the local Community House. Sam Snead was presented with five scrapbooks, which contained newspaper clippings of his activities as America's number 1 golfer, while at the Greenbrier. This scrapbook is said to contain such clippings as the visit of the Prince of Wales, 1919, and 125 other scrapbooks bearing upon the activities here since the opening of the first Greenbrier—these 125 books will go to the archives of the C. & O. Railroad at Richmond, Virginia. The golf course and swimming pool will remain open to the public for a brief period, pending negotiations. The personnel director of the surgeon general's office has arrived for the purpose of determining from the different department heads, who desires to remain in the service. The staffs of the diningroom, kitchen, and household-keeping departments are leaving for hotels in New York, Williamsburg, Cleveland, etc.

The interest of such a change in so historic a place as White Sulphus Springs, and this Greenbrier Hotel, spreads its wings to the very fringes of civilization, and once again places our "little Mountain State" in an enviable lime-light. To those of us who have even just glimpsed the place it passes before our fancied vision in new Kaleidoscopic colors for memory's casket. It carries us back to 1932, when our "Mount Vernon, Its Children, Its Romances, Its Allied Mansions and Families" had just come from the press in revised form, and brought to us an invitation among the other "Lee Authors" to attend "Lee Week" here. We had hoped



1858 - 1922

HERE STOOD A FAMOUS HOSTELRY
AFFECTIONATELY KNOWN AS

·THE·OLD·WHITE·

ONCE THE PRIDE OF THE OLD DOMINION

WHOSE GRACIOUS HOSPITALITY, BEAUTIFUL
SURROUNDINGS AND HEALING WATERS GAINED
NATIONAL RENOWN AND MADE IT THE OBJECT
OF MANY A PILGRIMAGE.

HERE GATHERED FROM THE NORTH AND SOUTH
GREAT GENERALS, FAMOUS STATESMEN AND
PHILANTHROPISTS, LOVELY LADIES AND
REIGNING BELLES "WHO LEFT UPON THE SILENT
SHORE OF MEMORY IMAGES AND PRECIOUS
THOUGHTS THAT SHALL NOT DIE AND
CANNOT BE DESTROYED".

ERECTED BY ITS SUCCESSOR
THE GREENBRIER
1940

One of the treasures placed in museums when the U.S. Government acquired the hotel.

In October 1942 the First Air Service Area Command took over the base and converted it to a Four-Engine Pilot Training School for the B-17 aircraft.

The procurement of military supplies and equipment and the construction of storage depots to house those supplies were also important elements of the District military mission. Among the storage depots built by the Huntington Engineers were the Parsel Army Air Force Specialized Storage Depot at Shelby, Ohio; the 833rd Army Air Forces Specialized Storage Depot at Zanesville; the 857th Army Air Forces Specialized Storage Depot at Huntington; and the Columbus Army Service Forces Depot, built originally by the Construction Division in 1918.

Huntington District took over construction at Columbus Depot in 1941 and built more barracks and thirty-one new warehouses to supplement the eight built by Major Quilty in 1918.

To supply the troops with weapons and ammunition, the Huntington Engineers built Buckeye Ordnance Works at South Point, Ohio; Marshall Chemical Warfare Service Plant at New Martinsville; Kanawha Chemical Warfare Service Plant at South Charleston; and the West Virginia Ordnance Works north of Point Pleasant in Mason County.

The magnitude of these ordnance plants is well illustrated by the West Virginia Ordnance Works, built on the 8,259 acre reservation of Camp Conley, a National Guard training camp prior to 1941. Fifty-seven contractors, employing over 5,000 men, undertook construction of a twelve-line production plant for TNT, a hundred concrete igloo-type magazines, administrative buildings, shops, dormitories, and 350 family housing units for workers.

TNT plants built before the war frequently took twenty-one months to build, but the Huntington Engineers, instructed to build in a hurry without using critical materials, used process buildings with asbestos siding, short-life utility materials, barbed wire fences, wood-frame buildings, and duckboard sidewalks, and completed the plant in seven months, even though an Ohio River flood in early 1943 held up work because the men could not get to the jobsite.

At the zenith of emergency construction, the Corps of Engineers, nationally, built military installations at the volume rate of $2 million a day. The peak was passed in June 1942, and as American troops began moving overseas the Corps military construction program was concentrated on projects in the combat theaters. General Eugene Reybold, Chief of Engineers, declared that by 1943 the Corps, by combining the heavy construction expertise of the Engineers and the building construction experience of the old Quartermaster Construction division, had become able to "move the Army and the Air Force any damned place there were Germans and Japs left to destroy, whether it meant building a truck road around the Himalayan Hump, rebuilding the wrecked ports of Italy, or ferrying heavy tanks across a flooded river. . . ."

The Army Engineers in the combat zones took fiendish pleasure in directing barbs at the other branches of the service, often leaving signs over bridges for the benefit of advancing infantrymen that read: "You cross this river with dry feet courtesy of the U.S. Engineers." But perhaps the story that best captured the Essayons spirit was told by Major General M.S. Eddy of the XIIth Army Corps, who said he once saw an Engineer captain rush out to set up a surveyor's transit in front of the lines and ordered him back posthaste, only to receive the reply: "We can't slow up just for the Germans, the men are laying that pipeline right on our tails." General Douglas MacArthur once commented that it was an "engineer's war." Perhaps he was right.

After the urgent mobilization construction began to taper off in late 1942, Colonel Wilson B. Higgins, Colonel Harry Pockras, and the Huntington Engineers continued building additions to basic facilities and procuring tons of equipment and supplies for the armed forces, and began construction of hospitals for the wounded and camps for prisoners. The District reconstructed Fletcher General Hospital at Cambridge, Ohio, converted the old Greenbrier Hotel at White Sulphur Springs, W. Va. into a hospital, and also built a POW camp at White Sulphur Springs.

Greenbrier Hotel, a six-story building with space for 800 guests, plus cottages, lodges, baths, and swimming pools, had been a popular mountain resort for over a century before the Corps acquired the property in 1942. The Huntington District acquired The Greenbrier in September 1942, and Area Engineer Cecil E. Mengerink supervised alterations to convert the hotel into an Army General Hospital. Captain Mengerink found few record drawings of the original buildings and prepared plans coincident with construction. Old partitions were removed, new walls built; new plumbing, wiring, heating systems, and elevators were installed; and two barracks were built. Despite labor and materials shortages, Captain Mengerink opened Ashford General Hospital for patients in November 1942, and completed the conversion in May 1943.

Colonel Harry Pockras received a phone call from the Ohio River Division on October 17, 1942 directing him to select a site for a thousand-man prisoner-of-war camp with a 150-man guard detachment and make report in five days. *Four days later*, Colonel Pockras reported that such a camp could be built for $421,000 on the Ashford General Hospital reservation at White Sulphur Springs.

The project was approved, and on December 21, 1942 Captain Mengerink began construction. Four CCC camps were dismantled and moved to the site to house prisoners, and messhalls, guard towers, a double-fence stockade, and other necessary facilities were erected. In spite of heavy rains and floods in Howard Creek, Mengerink and the contractors had the camp ready for occupancy by early April 1943, and did the job well within the cost estimates made by Colonel Pockras.

The Huntington Engineers supervised $165 million worth of military construction during World War II, which was only a small percentage of the $10.8 billion performed by the Corps throughout the nation. Nationally, the Corps procured military supplies at the rate of about $2 billion a year, and about 750,000 troops were enlisted in the Engineer service. Almost every contracting and engineering firm in the United States—5,300 firms—participated in the greatest emergency military construction program in history.

Building Floodwalls and Levees

Because of the impact of the war, the Corps flood control program was brought to a near-stop in 1942 to permit concentration of construction equipment and materials on the military projects. The Flood Control Act of 1941 had provided continued funding for many projects, but had authorized only a single new project in the nation—that project was Section III of the Huntington floodwall, to protect Guyandotte and the International Nickel Company plant. Discontinuance of construction at all civil works projects except those absolutely vital to the war effort was ordered in 1942, and this order ended work at the Massillon, Ohio, channelization project and Bluestone Dam on New River. The building of Section III of the Huntington floodwall continued.

The Huntington Floodwall Board took over operation and maintenance of the floodwall and levee in 1943. Early in that year, the floodwall prevented about $3 million in flood damages, and in March 1945 the wall saved the city an estimated $3.6 million in damages. But possibly more important for the nation as a whole was the protection furnished the International Nickel plant during the March 1945 flood, the third highest of record, be-

Construction on Section III (Guyandotte) of the Huntington Floodwall.

cause at the time the plant was producing materials vital to the Manhattan District, the top-secret Corps of Engineers District which was building the atomic bomb. Had the Huntington floodwall not been in place and functioning, the Nickel plant would have been closed by the flood, production facilities damaged; and, because operation of the plant was necessary for scheduled production of the nuclear bomb, it is quite probable that the use of the bomb to shorten the war would have been delayed by several weeks, or more.

Most of the Ohio River valley still had no flood protection in March 1945, and very heavy damages resulted. Twenty-four people lost their lives in the flood, 188 war production plants were shut down, and General Reybold, Chief of Engineers, told the House Committee on Flood Control that flood damages in the Ohio valley had totaled over $34 million.

The March 1945 flood vividly illustrated the value of flood protection projects, and Congress, foreseeing a need to provide employment for returning veterans, directed the Corps to begin planning for a massive flood control campaign in the postwar years.

Major public support for swift flood control construction was also generated by the '45 flood. The Ohio Valley Improvement Association, originally organized to support navigation improvements, turned its attention to flood control at its fiftieth anniversary convention in 1946 and resolved: "The Ohio Valley has now proved that it is capable of constituting the Citadel of Defense of the Nation in wartime. It is imperative that the industry, communications, and community organization of this region be protected effectively against the suspension of production, disruption of supply, and the breakdown of life and order which recurrently threaten so long as floods are permitted to continue a menace."

In 1946 military construction functions in the Ohio River Division were consolidated at Louisville Engineer District, and the Huntington Engineers resumed work on the flood control projects that had been suspended in 1942 and 1943. Colonel Harry Pockras doffed his uniform and resumed his duties as Chief of the District Engineering Division. For his services as wartime District Engineer, he was awarded the Legion of Merit, and for his role in rehabilitating the harbors of the Philippine Islands he received the Army Commendation Medal.

It will be recalled that the Huntington District was formed in 1922 by the merger of the Wheeling and Second Cincinnati Engineer districts. The old First Cincinnati District, founded by Colonel Merrill in 1870, had continued after 1922, with responsibility for a segment of the Ohio River and the tributaries—Scioto, Miami, Licking, and Kentucky rivers—that flowed into that segment. For military reasons, the Ohio River Division (ORD) moved from Cincinnati to Columbus in 1942. In 1946, with the close of the war and the reduction in military construction, the Ohio River Division returned to Cincinnati. The Office of the Chief of Engineers (OCE) planned to reduce administrative costs in 1946 by closing one of the Engineer Districts in the Ohio Valley, and orders were drawn up to close the Huntington District. The Ohio River Division, however, noting that to close the office at Huntington would deprive West Virginia of its sole Engineer District office, recommended closing the Cincinnati District office instead, and dividing its functions between the Huntington and Louisville Districts. OCE accepted this suggestion, and by orders of October 24 and December 5, 1946 the (First) Cincinnati District, once responsible for improvement of the entire Ohio River, was closed on the last day of 1946. Colonel Alexander M. Neilson, the last Cincinnati District Engineer, was appointed District Engineer at Huntington.

Colonel Neilson moved the Huntington District office from the Coal Exchange (Chesapeake and Ohio) Building, where it had been located since 1925, to new quarters in the Navy-owned Sylvania Building in 1947. Four years later the District office was moved again, to the Steiner Building, on Fourth Avenue in Huntington. Elements of the District office which had been scattered in temporary quarters in the Post Office Building and the Newton and Ritter buildings, were also moved to the Steiner Building in 1951. The Steiner Building was inadequate, however, to accommodate the 342 people who served in the District office in 1951, and the General Services Administration began planning a new building to house the many federal offices and employees stationed at Huntington.

As a result of the postwar reorganization, the Huntington District boundary was extended down the Ohio River to Rivermile 409.3. The Huntington Engineers acquired from the old Cincinnati District responsibility for Ohio River Locks and Dams 29 to 33, completion of local protection projects at Ironton and Portsmouth-New Boston, Ohio, planning for thirty-six other local protection projects, and planning for the five flood control reservoirs then under consideration in the Scioto River basin.

The Ironton project, like the Huntington floodwall, was authorized by the 1937 Flood Control Act and it was one of the first local protection projects completed in the United States. Congressman Thomas A. Jenkins, an Ironton native, told the House Committee on Flood Control in 1940 that swift initiation of the Ironton project had been possible because "we proceeded immediately with proper legislation so as to enable us to qualify under the law. I am proud that we were the first." In April 1938 the Cincinnati District had begun construction of the six miles of earth levee and mile of

Construction of floodwall at Portsmouth, Ohio June 15, 1948.

concrete floodwall along the Ohio River front and up Storm Creek to protect Ironton against a flood the height of that of 1937. The Cincinnati District turned the project over to Ironton for operation and maintenance in June 1943—Huntington District performed remedial work on the Storm Creek diversion channel from 1949 to 1952. Built at a cost of just over $2.5 million, and operated and maintained for less than $40,000 a year, the Ironton project paid for itself several times over, and, for the most part, the people of Ironton forgot the 1937 catastrophe when the entire town was flooded, 13,300 people made refugees, and one person drowned.

Portsmouth, it will be remembered, had built a floodwall after the 1907 flood. The municipal floodwall repaid its costs during several floods, but the 1937 superflood put ten feet of water over the wall. At the request of Portsmouth City Manager Frank E. Sheehan and Albert F. Marting and the Portsmouth-New Boston Flood Control Committee, Congress approved a local protection project for Portsmouth and adjoining New Boston in 1938. The Cincinnati District began construction of the floodwall in 1940, but because of the delays incident to the war had not finished the project when the flood of March 1945 climbed up the levee. The Engineers saved the cities from serious damages, however, by quick emergency work, placing more than 200,000 sandbags on the uncompleted portions of the wall and levee. Construction was resumed in 1946, and the Huntington District became responsible for the project in 1947.

The Portsmouth-New Boston project involved building about four miles of earth levee and four miles of reinforced concrete floodwall, the relocation of the lower Scioto River channel, and the installation of sixteen traffic openings and gates and twelve pumping stations. To expedite floodwall construction, assembly-line methods were devised by the contractor, Dravo Corporation. Light railtracks were placed along the site of the wall and gantries moved down the tracks to place and remove the forms, moving them from section to section, and to lift concrete buckets from trucks to pour concrete into the forms. Huntington District turned the project over to Portsmouth and New Boston for operation and maintenance in May 1950 and children can again be seen shooting marbles on the streets while over their heads spring floodwaters swirl outside the floodwall.

Congress had authorized many floodwalls and levees—local flood protection projects—in 1937 and 1938, but only a few were begun before 1941, largely because of the reluctance of communities to tax themselves to pay their share of the costs.

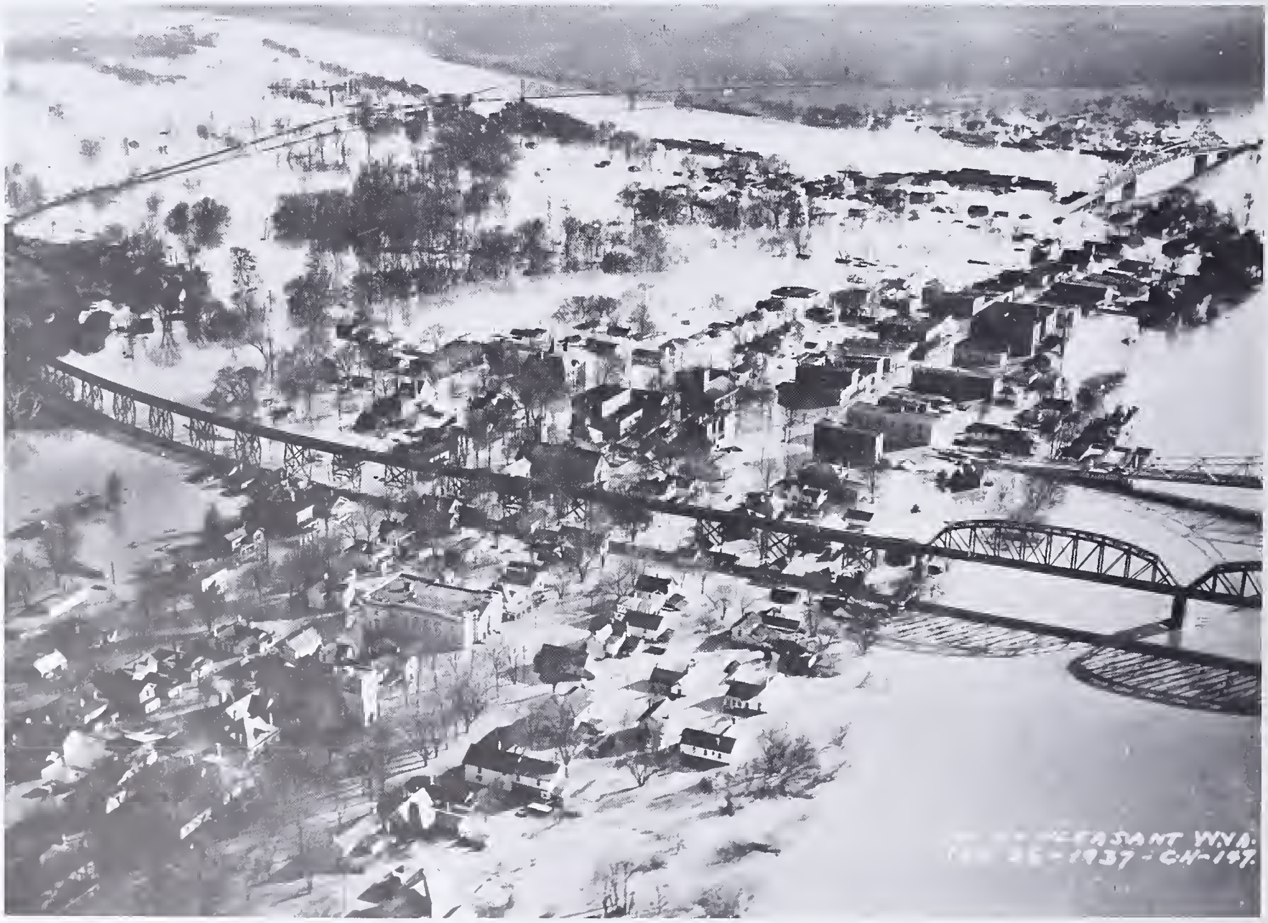
Federal laws required that communities participate in funding local protection projects, ordinarily by paying the costs of relocating utility lines, roads, and the like, furnishing rights-of-way and spoil areas, and paying any damage claims arising from construction.

Local protection projects pay high dividends on the initial investment because they provide immediate protection for urban areas, and highly productive agricultural lands and, by preventing flood damages, restore the confidence of the people in the protected area that their efforts to improve and beautify their property will not be in vain. Nevertheless, communities have often neglected local protection projects until a major flood disaster convinces citizens of the value of such protection—and before 1941 rumors were circulated that the federal government might eventually bear the entire cost of local protection projects.

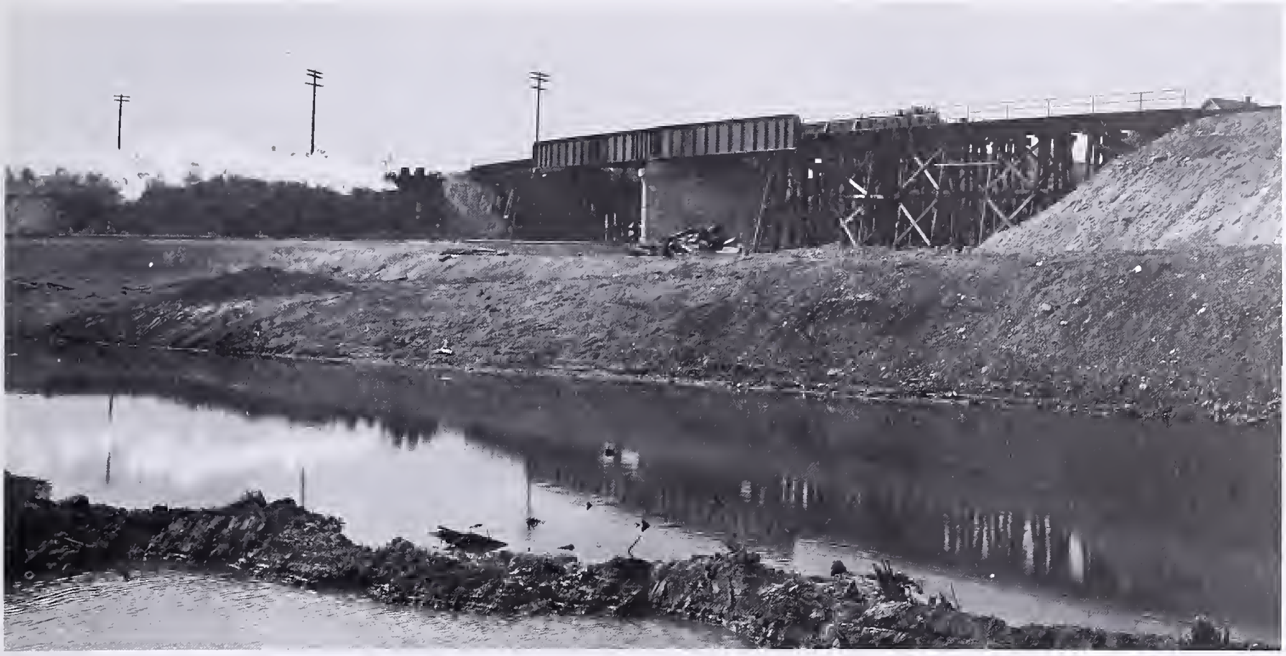
The mayor of Point Pleasant, at the junction of the Ohio and Kanawha rivers, told Huntington District Engineer Joseph D. Arthur in 1938 the city could not afford the costs of a local flood protection project and was considering evacuating the low-lying parts of the town permanently. The flood of March 1945, atop the damages left by the 1937 flood, convinced citizens of Point Pleasant that a floodwall to protect about 60 percent of the town was necessary, and local cooperation in the project was arranged. The Huntington Engineers revised the plans for Point Pleasant just after the end of World War II and began construction of a 7,305-foot concrete floodwall and 4,740-foot earth levee, plus gate openings and pumping stations, in 1943, and turned the completed project over to the city in 1951.

A similar project was built between 1946 and 1950 at Parkersburg, at the confluence of the Ohio and Little Kanawha rivers. Because Parkersburg was one of the few points on the Ohio where the 1936 and 1937 floods had not exceeded the 1913 flood crest, the Parkersburg wall was built to provide three feet of freeboard above the 1913 record.

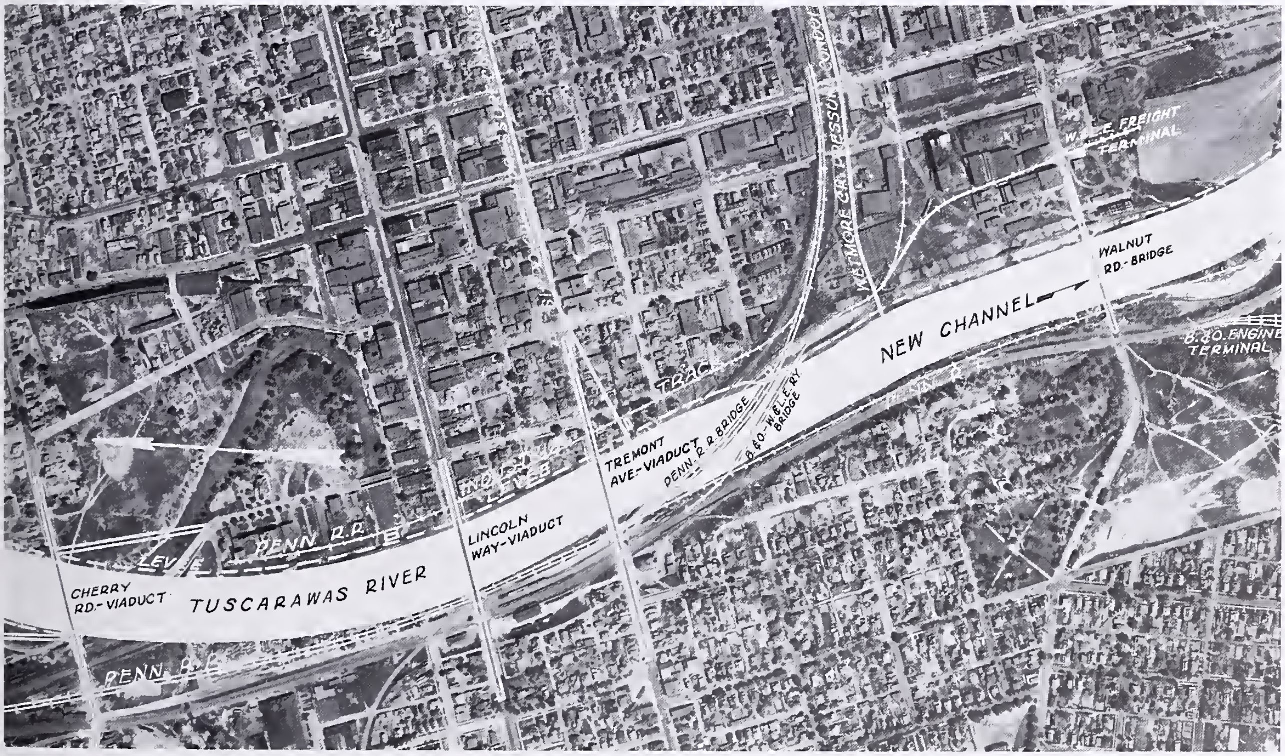
Channel rectification projects were completed at



Point Pleasant, West Virginia, January 26, 1937. This town was ninety percent covered by the 1937 flood and was later protected by a floodwall completed in 1951.



Local Protection Project at Massillon, Ohio, Section–1. View across the new Tuscarawas River channel showing a new girder and trestle bridge over the B&O and W&LE main lines in October 1943.


W.&L.E. FREIGHT TERMINAL
WETMORE CR. SUBWAY
WALNUT RD.-BRIDGE
NEW CHANNEL
B.&O. ENGINE TERMINAL
TRACK
B.&O.-W.&L.E. RY. BRIDGE
PENN. R.R. BRIDGE
TREMONT AVE.-VIADUCT
INDUSTRIAL LEVEE
LINCOLN WAY-VIADUCT
PENN. R.R.
LEVEE
CHERRY RD.-VIADUCT
TUSCARAWAS RIVER
PENN. R.R.

Local Protection Project, Massillon, Ohio. Aerial photograph used to map changes in river channel, railroad relocation and levee placement.

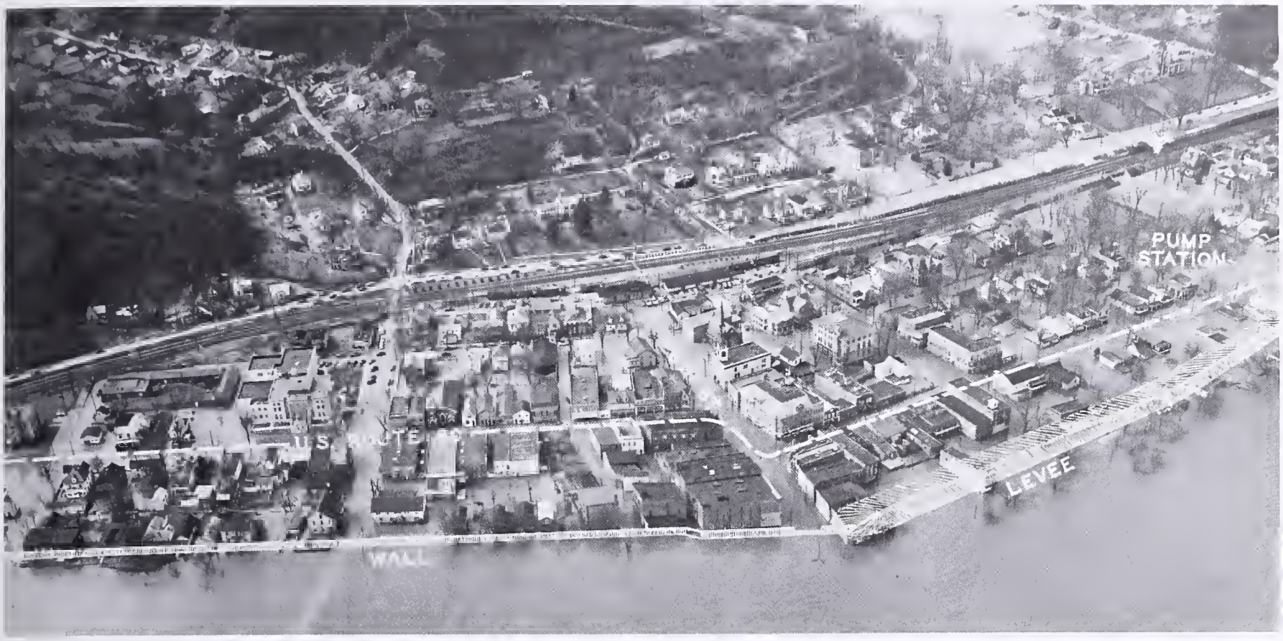
General view of Galax, Virginia, during the flood of August 1940. Chestnut Creek was straightened, deepened and widened by the Corps of Engineers provide flood protection and completed in 1951.

Massillon, Ohio, and Galax, Va. in 1951. The Massillon project—enlarging the channel of the Tuscarawas River through the city to carry a flood 20 percent greater than that of 1913—had been begun in 1940 and stopped during the war. The Huntington Engineers resumed work at Massillon in 1946 and completed the project in 1951.

Galax, in Grayson and Carroll counties, Va. suffered nearly annual floods from Chestnut Creek, a New River tributary, and in August 1940 the town was severely damaged. Civic leaders appealed to Congress for help, but Secretary of War Henry L. Stimson requested that, because of the urgency of military construction, the Galax project be deferred till the end of the war. Congress agreed and did not fund the project until the late 1940's. When funds were made available the Huntington Engineers straightened, deepended, and widened Chestnut Creek through the town in a ten-month construction period, turning the project over to Galax for maintenance in April 1951.

The District also got floodwall and levee projects underway along the Ohio River at Ashland, Russell, Maysville, and Catlettsburg, Ky., during the postwar years and completed them during the Eisenhower administration. Each of these projects resembled the others in many respects, and each was the source of benefits in addition to those resulting from prevention of flood damages.

Catlettsburg, for example, had at one time been the trading center for the Big Sandy valley; the city had elaborate hotels, saloons, an opera house, and a racetrack where timber raftsmen and Big Sandy boatmen regularly divested themselves of their earnings in the rivertrade. But the end of Big Sandy River navigation in the early twentieth century, followed by economic depression and the 1937 flood disaster, prostrated the city. Thirty-six floods visited the city between 1884 and 1955, and businessmen were reluctant to build or improve buildings in the downtown area. Catlettsburg decided to remedy the situation in 1955 and agreed to participate in construction of the local flood protection project authorized by Congress in 1938. John Taylor, resident engineer for Huntington District, directed construction of a multisection levee and floodwall along the Ohio River front and up the left bank of the Big Sandy River to Peterman Creek between 1956 and 1959. In the meantime, civic leaders and the city government in Catlettsburg began a radical remodeling and rebuilding program, investing more than a million dollars in renewal projects. This investment was protected in 1959, when, for the first time, Catlettsburg was dry during a major flood. Robert Stanley, chairman of the Catlettsburg Floodwall Commission, declared it was a "good feeling" to know that flood ravages were a thing of the past.


PUMP STATION
U.S. ROUTE
LEVEE
WALL

Aerial photograph illustrating the proposed levee and floodwall for Catlettsburg, Kentucky.

YES
FLOOD WALL

Catlettsburg, Kentucky, during flood on the Ohio and Big Sandy Rivers in 1955. Note sign on house "Vote YES for Flood Wall."

Bluestone and Other Lakes Completed

While the quick-result local protection projects were underway, the Huntington Engineers resumed work on Bluestone Dam and Reservoir on New River and began several other reservoirs for flood control. Bluestone Dam had been only about a third completed when construction was suspended by the war; the Huntington Engineers renewed construction in January 1946, pouring a million cubic yards of concrete to build an immense 165-foot-high and 2,048-foot-long dam. Six penstocks were installed in the dam to pass water through to a powerhouse, but in 1944 the Engineers decided to defer hydroelectric power production at Bluestone so as to permit full use of reservoir storage capacity for flood control until other reservoirs with sufficient capacity to handle New and Kanawha river floods were put in operation. The penstocks were sealed with bulkheads, and not a single watt of electric power was ever produced at Bluestone Dam.

The "*Mighty Sentinel of the Kanawha Valley*" blocked the path of a December 1950 flood, storing 121,400 acre-feet of water and knocking four feet off the crest at Hinton and ten feet off the top at Charleston, saving those cities from catastrophic losses. Within twelve years after its completion, Bluestone Dam had averted flood damages of over twice the cost of construction. Congressman James Kee was pleased to recall in 1962 that his father, Congressman John Kee, had led the fight in 1932 against those who predicted Bluestone Reservoir would become a mudhole. He declared that beautiful Bluestone Lake had become a regional recreation center and, thereby, the "economic lifeline of Hinton."

Other flood control reservoir projects begun by the Huntington Engineers in the immediate postwar era included Sutton Dam and Reservoir on Elk River in the Kanawha basin, Dillon Dam on the Licking River in the Muskingum basin, Dewey Reservoir on Johns Creek in the Big Sandy basin, and Delaware Reservoir on Olentangy River in the Scioto basin, the latter project inherited from the Cincinnati District as a result of the 1947 consolidation. These major efforts to achieve a measure of flood control were interrupted, however, by the second emergency military construction mission in a decade, when the Cold War warmed up in Korea.

Military Building during Korea and After

From 1945 to 1950, military construction had

Construction of dam at Bluestone Reservoir Project, June 1946.

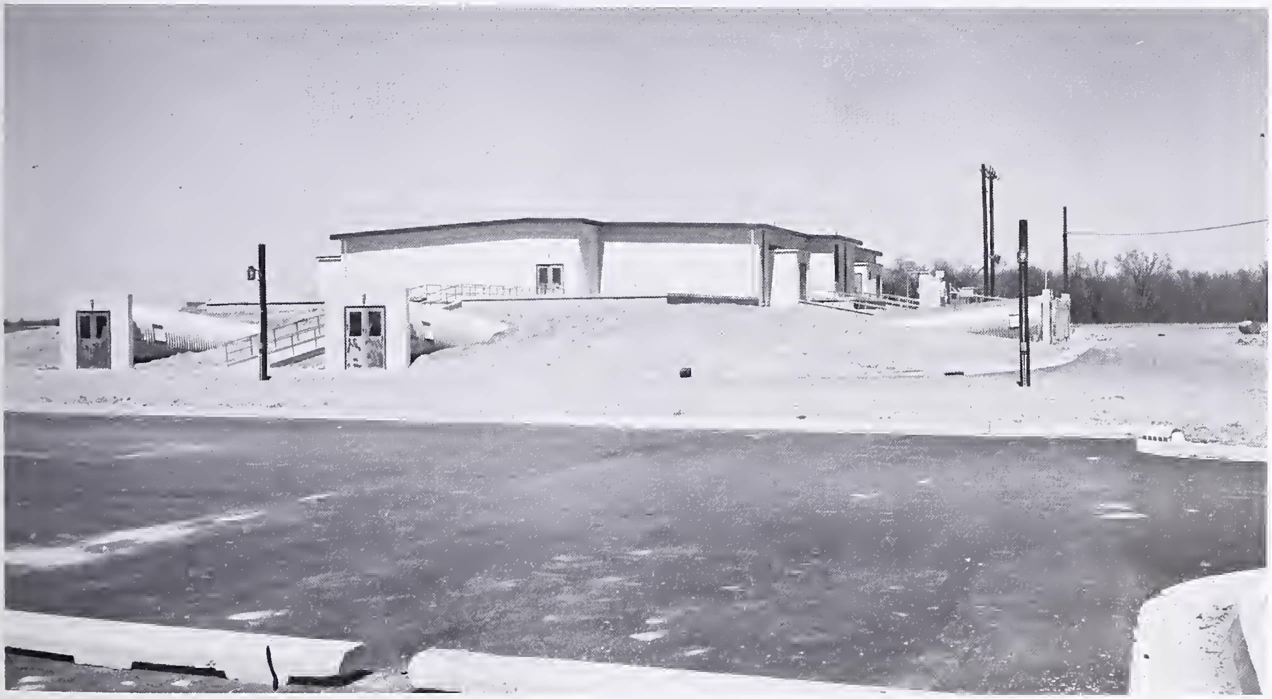
been largely routine, and the Louisville Engineer District supervised military construction for Ohio River Division, but in late 1950 American forces in Korea suffered serious setbacks—in one engagement the Second Engineer Battalion of the Second Army Division suffered over 50 percent casualties while fighting a rearguard action, and this loss was typical of those of many other units trapped in the rugged terrain of Korea. Construction of flood control projects was again interrupted in 1951 when President Harry S. Truman ordered that work be limited to those projects "directly contributing to national defense or to civilian requirements essential in the changed international situation."

The Corps of Engineers was ordered in 1951 to launch a crash construction program to rehabilitate old and build new airfields, depots, hospitals, and similar military facilities at more than 700 domestic bases and in more than twenty foreign countries. The Huntington Engineers, assigned responsibility for military construction in West Virginia and Ohio, began building new facilities, or "retreading" old projects of World War II vintage.

During and after the Korean "police action," the District built and renovated airfields at Akron-Canton, Cincinnati, Mansfield, Shelby, Youngstown, Toledo, and Wilmington, Ohio, and at Martinsburg and Charleston, W. Va. The Area Office at Mansfield, Ohio, under Project Engineer Walter Glasgow, built longer runways at Mansfield Municipal Airport to serve the jet aircraft of the 164th Fighter Squadron of the Ohio National Guard. Harry R. Irwin and Wright McCroba directed similar work at Toledo Express Airport in Lucas county, Ohio, extending runways built for propeller aircraft to a 7,000-foot length to accommodate jet planes and building hangars, warehouses, service buildings, fuel and rocket storage facilities, and roads and utility lines to serve the aircraft and their crews.

Thomas Chapman and the staff at the Martinsburg Area Office in the Shenandoah Valley built longer runways for the jets of the West Virginia National Guard and related plane-servicing facilities at Martinsburg Municipal Airport. At Wilmington, Ohio, Project Engineers Karl M. Barth and F.M. Tracy renovated and modernized the Clinton County Air Force Base, originally built by Cincinnati Engineer District in 1943, for use by the 302d Troop Carrier Wing as a Reserve Training Center by extending the original runways and erecting about thirty-five buildings. The Wilmington office also supervised construction of the Springfield Army Reserve Training Center and the rehabilitation of Kings Mills Ordnance Plant at Kings Mills, Ohio.

The renovation of Lockbourne Air Force Base near Columbus was the largest military project

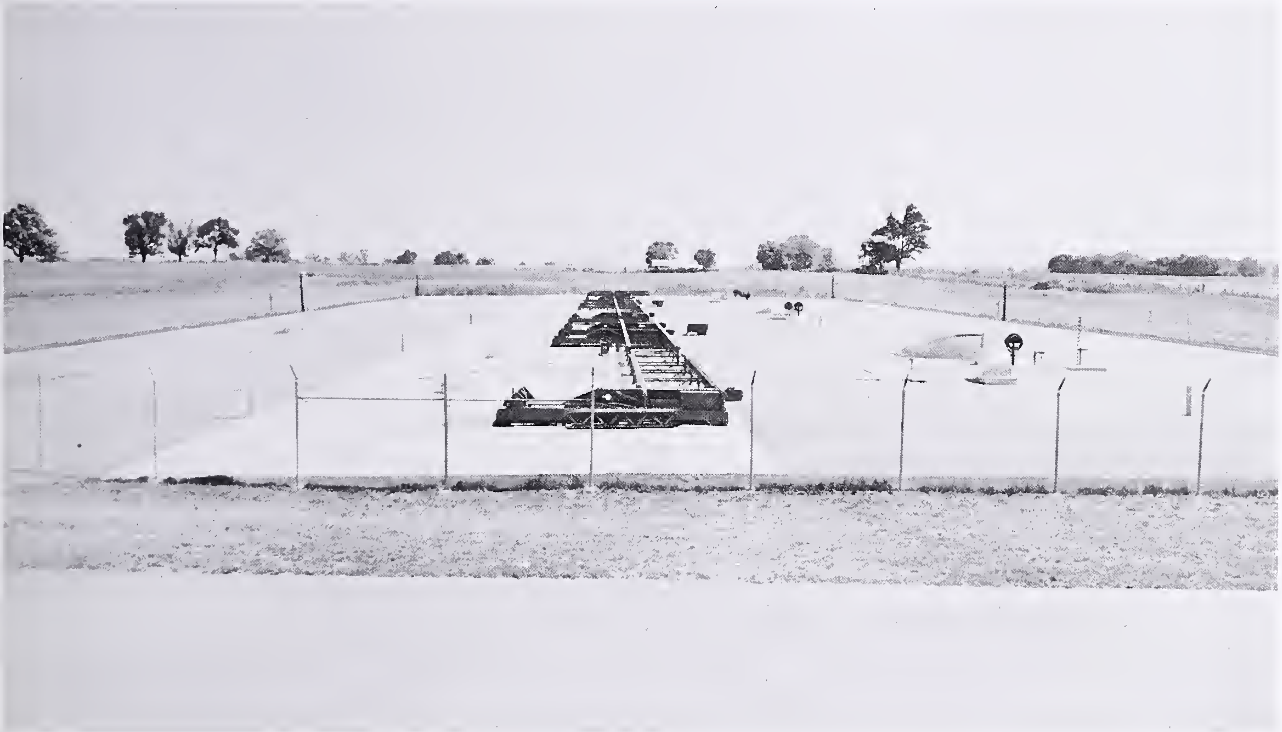


View of completed Readiness Crew Building at Clinton County Air Force Base, April 1960.

Administration buildings at Lockbourne Air Force Base erected during the renovation of the base in the late 50's.

New taxiway completed at Lockbourne Air Force Base in November 1959.

NIKE Launching site under construction in August 1959 at Hillsboro, Indiana for the Cincinnati Defense Area.



Completed launching site in the Cincinnati Defense Area in 1960.

handled by the Huntington Engineers during the 1950's. Millions were spent to build longer, heavier runways for the giant B-52 aircraft of the Strategic Air Command, enormous aircraft hangars, maintenance shops, service and administrative buildings, and housing for 8,000 airmen. Karl C. Vogel, Harry Irwin, and James J. Rose and their colleagues at Lockbourne supervised a huge building program, yet still were able to develop and implement some innovative engineering techniques.

National attention was drawn to the Lockbourne project because of the construction of two double cantilever aircraft hangars for the B-52s, the building of dormitories with the Youtz-Slick Lift Slab Method, the installation of a pioneering high temperature hot water heating system, and the use of sawed-joint pavement construction methods. Buildings at Lockbourne were heated by hot water, instead of steam, which passed through miles of supply and return piping at a temperature of 400 degrees; the system reduced installation costs and fuel consumption by as much as 40 percent, in comparison with comparable steam heating systems, and maintenance costs were lower. Runway pavements built during World War II with hand-formed contraction joints had badly deteriorated at the joints, leaving an uneven pavement surface, and Karl C. Vogel and the contractors began experiments with sawing joints into a nearly continuous concrete slab. After several experiments, Vogel developed a system of sawing and bevelling hardened concrete to open contraction joints without building expensive forms, and leaving a relatively smooth landing surface with ample space at the joints for deterioration-resistant filler.

Role in Missile Program

Military construction under Huntington District supervision tapered off after the flurry of emergency construction during the Korean incident, but in 1957, with the advent of Sputnik and the Space Age, the Huntington District was assigned a role in the national missile program. In 1958 and 1959, Project Engineer Robert Ledford

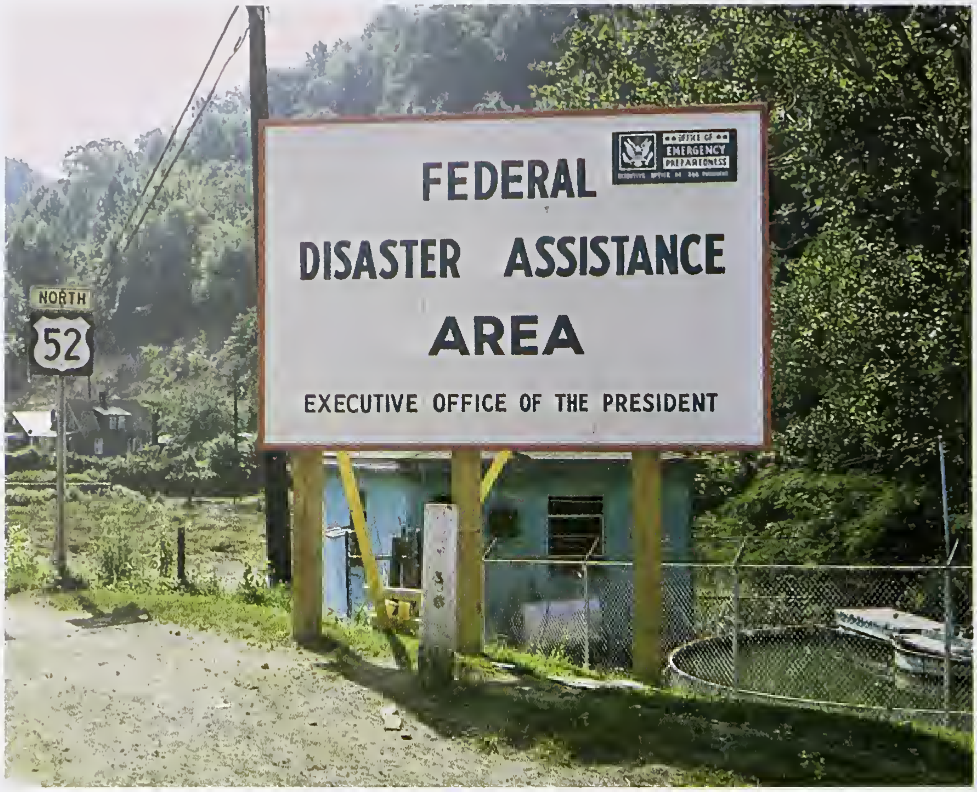
Veterans Administration Hospital under construction at Clarksburg, West Virginia, July 1949.

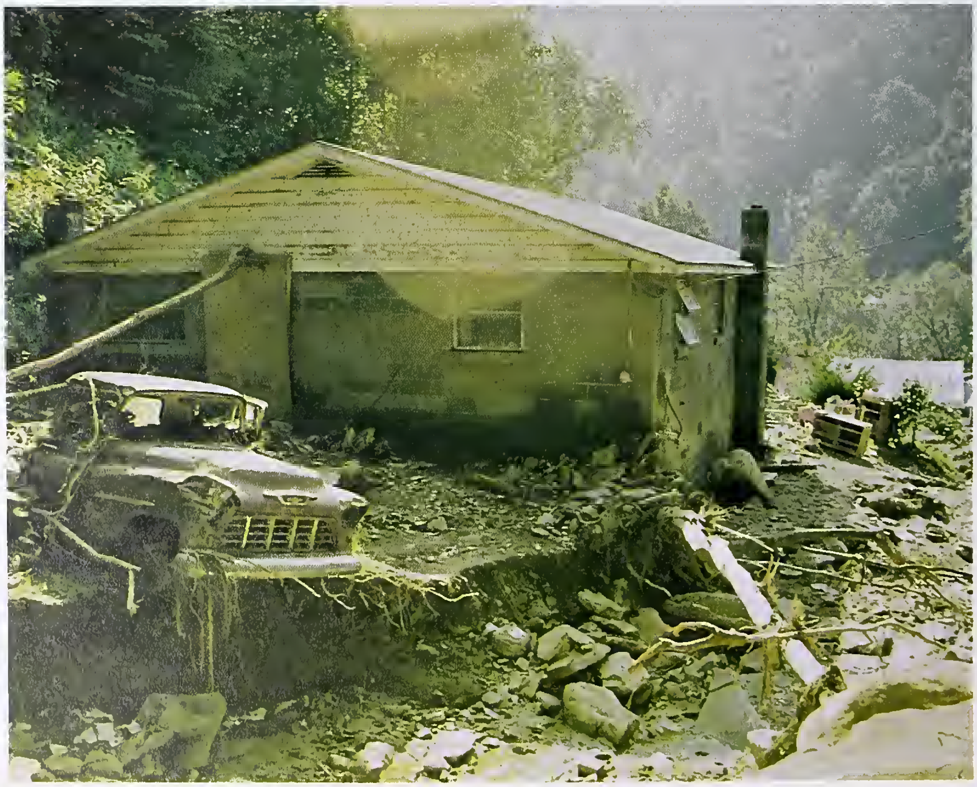
directed the Cincinnati Defense Area Project from an office at Wilmington, Ohio. This project consisted of the construction of four NIKE missile bases around the "Queen City" to protect it against surprise atomic attack. The Engineers built more than 250 NIKE bases throughout the United States around major population-industrial centers during the era when the nation appeared to be second in the missile race and there was widespread fear of sudden nuclear attack over such issues as the Suez Canal, the Berlin Wall, and Cuba.

During the late years of the Eisenhower administration the Huntington District completed a Chemical Corps plant at Natrium, W. Va., Guthrie Air Force Station near Charleston, about a dozen Army Reserve Centers and supply depots, and two large Veterans' Administration Hospitals, at Clarksburg and Beckley, W. Va. With the growing emphasis on missile defenses and corresponding reduction in airfield construction, however, it became uneconomical to maintain administrative headquarters for military construction in all Engineer Districts, and in May 1961, in an effort to reduce personnel and save about $13 million annually, the Chief of Engineers withdrew military construction from twelve Engineer Districts. Huntington District was one of the twelve. After 1961, military projects in the Huntington District were administered by a staff operating out of the Louisville Engineer District office.

Frequently performed on a crash basis and always under tight security, military construction was challenging and sometimes exciting work, and many men and women in the Huntington District regretted the loss of the military mission. The District civil works organization had, however, proven on two occasions, in 1941 and 1951, that it could rise to the challenge in national emergencies and perform effectively under pressure. It had established a reputation as an organization that could cope with any emergency situation, and, again and again, in the years after 1961, Congress and the President were to turn to the Army Engineers and the Huntington District for quick action in disaster and emergency situations.

Completed Veterans Administration Hospital at Beckley, West Virginia August 1952.


FEDERAL
DISASTER ASSISTANCE
AREA
EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF EMERGENCY PREPAREDNESS
NORTH
52



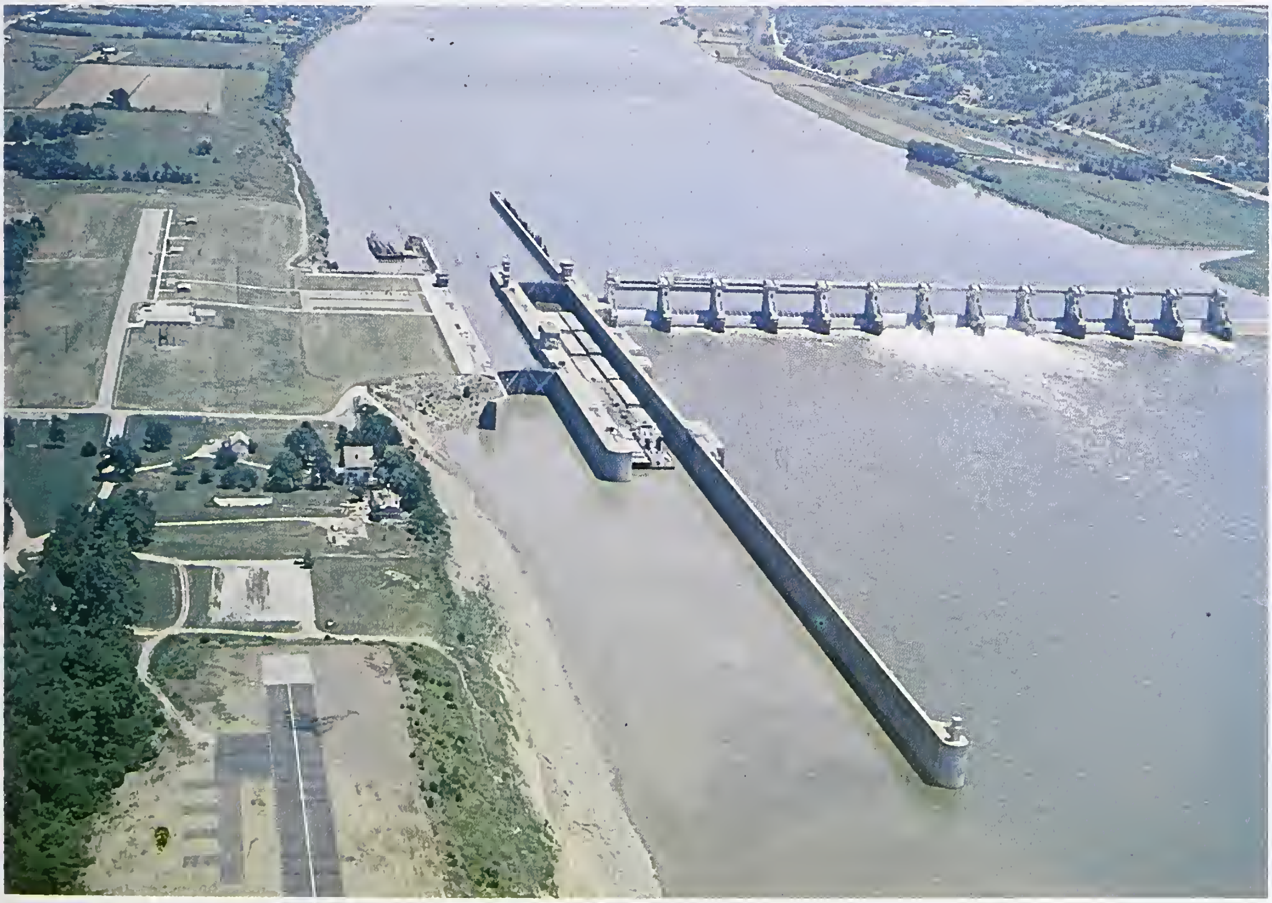
Gilbert, West Virginia, area flood of August 1972. This disaster was declared a national emergency and the Huntington District, Corps of Engineers, was called in for clean-up and restoration by the Office of Emergency Planning, Executive Office of the President.

Chapter XII

The Riverine Revolution

THE winking golden glow of the radarscope sweeping La Belle Riviere ahead of the massive tow dimly lighted the pilothouse. Standing at the center of the complex control panel, the Captain alternately gazed out at the swirling fog, glanced at the steadily rotating light of the radarscope, flicked on his flashlight to examine the navigation charts he had picked up at Huntington, and twisted the chrome-plated controls to adjust the course of the tow. The heavily laden barges ahead of him were lashed in a tow so long that he could see its nose on the radar, but had difficulty peering through the fog to see the lights on the bow.

Radar still showed the petroleum tow that had glided silently past on its way upriver, and it showed the outlines of Captain Anthony Meldahl Locks and Dam, a massive barrier astride the channel just a few minutes ahead. The Captain eased back the controls of the twin diesel engines that were driving the immense barge-tow downriver and felt the boat gently vibrate as the powerful engines slowed. He punched the talk button on the "squawkbox" overhead and said, "Get ready, Jim, we're coming into Meldahl. The



Captain Anthony Meldahl Locks and Dam on the Ohio River upstream of Cincinnati, Ohio.

Inside the pilot house of a modern towboat showing controls, radar and other navigational equipment.

lockman radioed it was all clear a moment ago."

"Yes suh, Cap'n," drawled the Cajun first mate, who was out on the bow of the tow with deckhands ready to guide the nose of the tow into the lock and snub the barges with ropes to the floating mooring bits. "I kin see 'er lights now."

The Captain at that moment also saw the lights on the guidewalls leading in to the giant 1,200-foot lock—*long* enough to lock through a battleship. He reversed the propellers, churning up a furious wave behind and eased the tow to a near stop.

"Bring 'er on ahead, Cap'n," the first mate called over the radio. "Gates 're open. You're on line and 'bout a hundred foot out." The Captain manipulated the controls while the deckhands scurried to the ropes. "Fifty foot, come ahead cap'n. . . . Twenty-five, hold 'er steady. . . . Ten foot out, cap'n. . . . Okay, you're in!"

The Captain felt the reassuring bump that comes as the tow lines up with the guidewalls, revved the throbbing engines to slide the bow gently into the lock chamber, then cautiously, by inches, eased the immense tow toward the lower lock gates. In the bright lights surrounding the lock, the Captain could see the lockmen, wearing their life preservers and hardhats emblazoned with the red Engineer castle, making certain the deckhands lashed the tow securely to the mooring bitts. After the enormous mitering lock gates

Captain Anthony Meldahl at the wheel of the Queen City, one of the many packetboats he piloted during his career on the Ohio River.

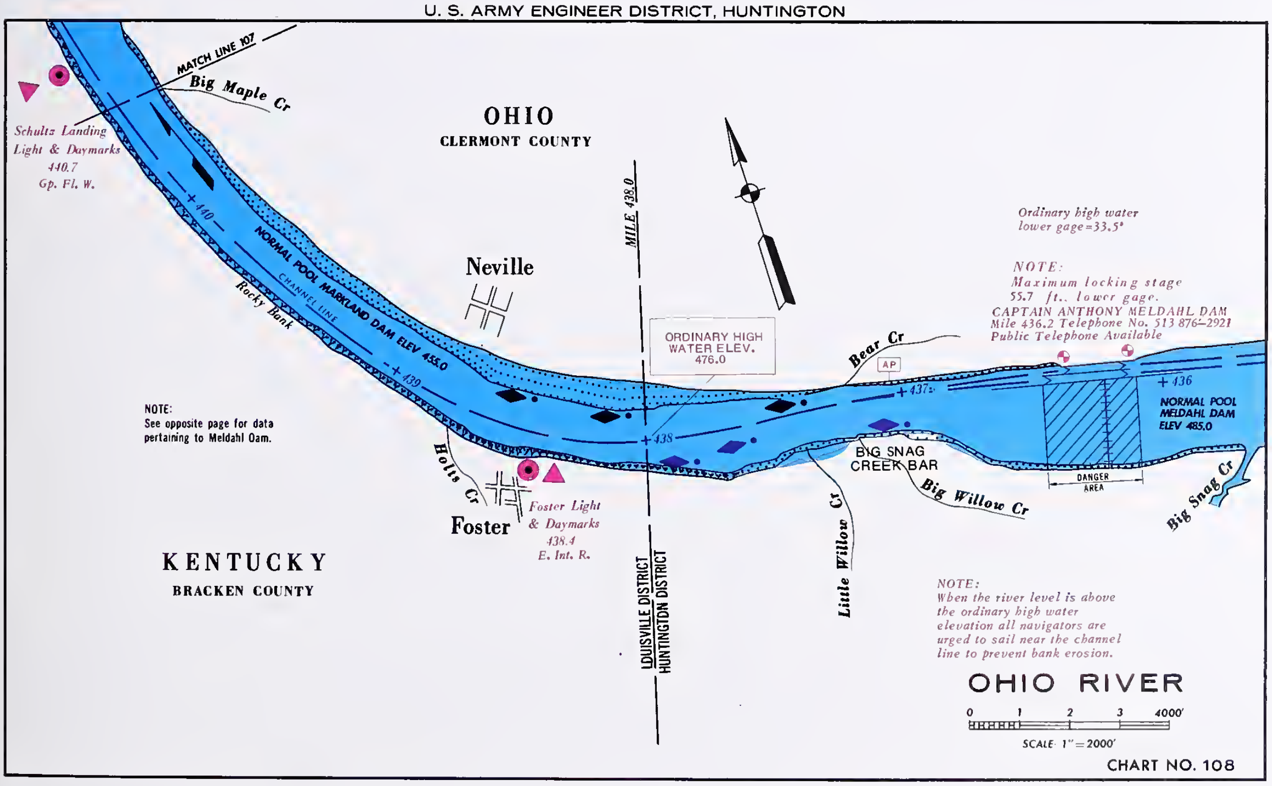
closed behind, the Captain turned the controls over to the master pilot, whose six-hour shift was just beginning, and stepped to the rear of the pilothouse to light a cigar.

Meldahl Locks and Dam was impressive, the Captain mused as the match flickered out. His father had piloted some of the gaudy gingerbread-trimmed steamboats just after the turn of the century and had known Captain Anthony "Tony" Meldahl when Meldahl was piloting the Engineer towboat *Cayuga*. Pa once told the story of how Captain Meldahl almost lost his head when the steam packet *Queen City* hit the railroad bridge at Kenova at high water—the *Queen City* pilothouse had been smashed to splinters and a wire had caught the old river captain by the neck, but the wire snapped just before shortening him by about a foot. Captain Meldahl must have been quite a fellow—at least, the writers in *The Waterways Journal* and *S & D Reflector* so remembered him.

The Captain recalled his father thought nothing would ever replace the steamboats and the old wicket dams on the Ohio. "They'll never improve on those wicket dams," Pa had once said. "Why, they can put those dams down on the bottom and I can take any boat on the river clear to New Orleans without locking." Nevertheless, Pa would probably have approved of these new locks and dams; certainly he would have liked the floating mooring bitts, for he had nearly lost a boat on a snubbing post at old Lock 17.

The Captain himself marveled at the new locks and dams. Just ten years before, bringing a tow down from Greenup at low water, he had locked through old Locks 31, 32, 33, and 34, double-locking at each by putting through the first section of the tow in the first lockage, following with the rest of the tow and the towboat in the second lockage and cabling the tow back together below the lock. The company had lost money on that trip. Tonight, he had eased down the ninety-five miles of deep slackwater quickly, and in a single lockage he would be through Meldahl Lock and off down another long pool that would take him to Cincinnati.

The tow was down to the lower pool, the huge gates swung open, and the pilot made the diesels roar as he pushed the barges out of Meldahl Lock toward the Queen City. "Ought to be there by daybreak," the Captain thought as he ground out his cigar butt. Looking back at the big gates closing, he wondered how they had been built. "Sure made life on the river easier," he mused as he


U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
MATCH LINE 107
Big Maple Cr
Schultz Landing Light & Daymarks 440.7 Gp. Fl. W.
OHIO
CLERMONT COUNTY
MILE 438.0
Neville
Ordinary high water lower gage=33.5'
NOTE: Maximum locking stage 55.7 ft., lower gage.
CAPTAIN ANTHONY MELDAHL DAM
Mile 436.2 Telephone No. 513 876-2921
Public Telephone Available
+440
NORMAL POOL MARKLAND DAM ELEV 455.0
CHANNEL LINE
Rocky Bank
+439
ORDINARY HIGH WATER ELEV. 476.0
Bear Cr
AP
+437
+436
NORMAL POOL MELDAHL DAM ELEV 485.0
+438
BIG SNAG CREEK BAR
Big Willow Cr
DANGER AREA
Big Snag Cr
NOTE: See opposite page for data pertaining to Meldahl Dam.
Holts Cr
Foster Light & Daymarks 438.4 E. Int. R.
Foster
KENTUCKY
BRACKEN COUNTY
LOUISVILLE DISTRICT
HUNTINGTON DISTRICT
Little Willow Cr
NOTE: When the river level is above the ordinary high water elevation all navigators are urged to sail near the channel line to prevent bank erosion.
OHIO RIVER
0 1 2 3 4000'
SCALE 1"=2000'
CHART NO. 108

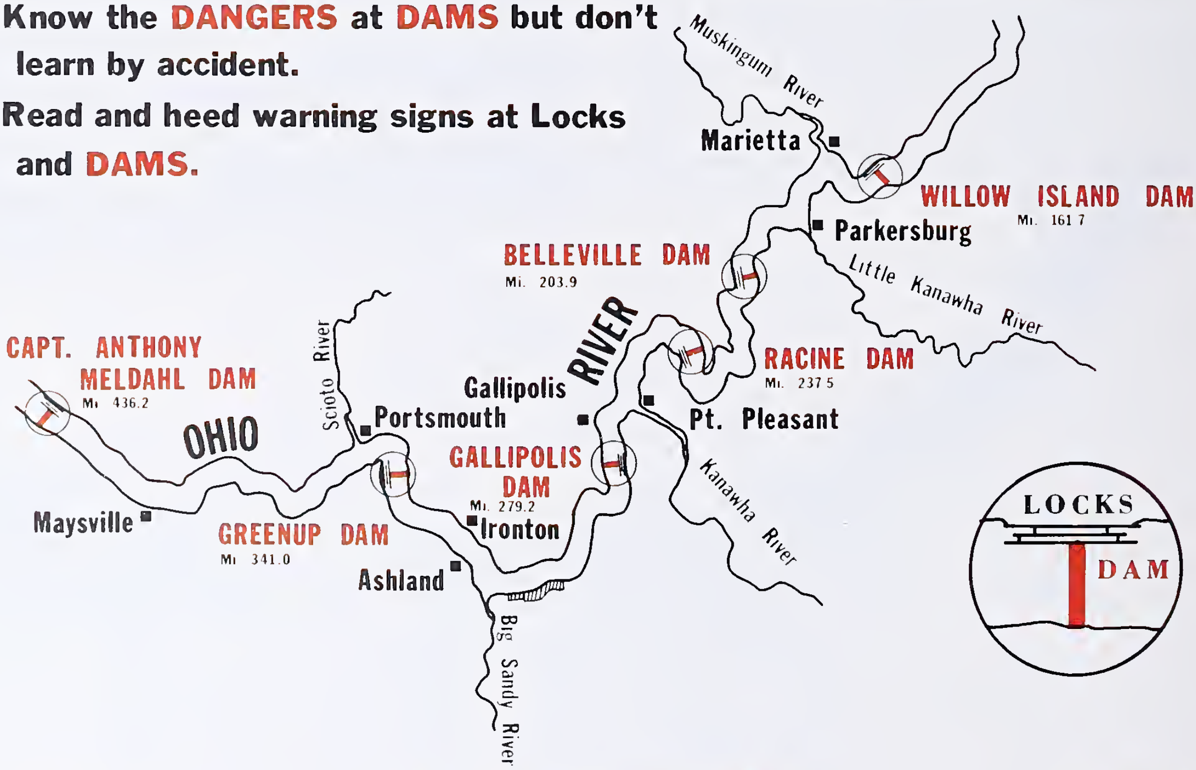
Typical chart used by river pilots and pleasure craft operators to navigate the Ohio River. These charts are available at all Corps offices for all major rivers and navigable tributaries in the United States.

TO ALL SMALL BOAT OPERATORS

BE "DAM" CONSCIOUS

BE AWARE OF DANGER AT DAMS

1. **Know your location on the river with respect to each DAM and Locks.**
2. **Obtain current navigation charts from the Corps of Engineers.**
3. **Update your charts using Corps of Engineers Notice to Navigation Interests and U.S. Coast Guard Notice to Mariners.**
4. **Stay at least 1000 feet above and 1500 feet below DAMS; remember there are DANGEROUS currents.**
5. **Approach every DAM along the bank next to the Lock and at reduced speed.**
6. **Know the DANGERS at DAMS but don't learn by accident.**
7. **Read and heed warning signs at Locks and DAMS.**


Muskingum River
Marietta
WILLOW ISLAND DAM
Mi. 161.7
Parkersburg
Little Kanawha River
BELLEVILLE DAM
Mi. 203.9
RIVER
RACINE DAM
Mi. 237.5
Gallipolis
Pt. Pleasant
CAPT. ANTHONY MELDAHL DAM
Mi 436.2
OHIO
Scioto River
Portsmouth
GALLIPOLIS DAM
Mi. 279.2
Kanawha River
Ironton
Maysville
GREENUP DAM
Mi 341.0
Ashland
Big Sandy River
LOCKS
DAM

BE ALERT

BE SAFETY MINDED

BE SAFE

U.S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, W. VA.

PASS ALONG TO OTHER OPERATORS

A word of CAUTION to all boat operators that is included with navigation charts.

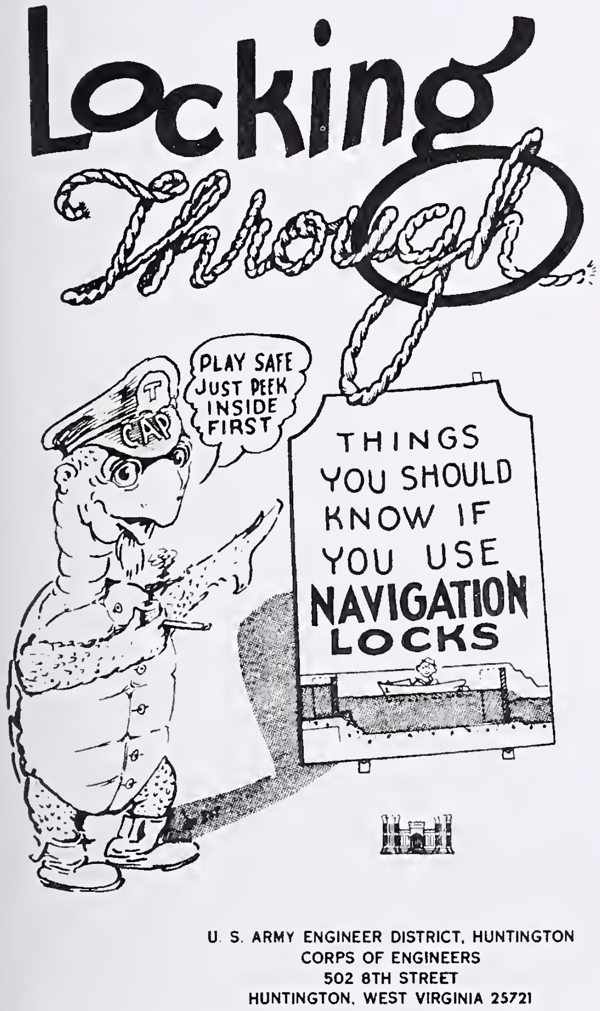
headed down to the galley for hot coffee. “Must have been those Engineers at Huntington,” where he had picked up the new navigation charts.

A Modern Navigation System

The Huntington Engineers had indeed built Captain Anthony Meldahl Locks and Dam, and the other new locks and dams at Greenup, Racine, Belleville, and Willow Island. They had been building on the modernized system for nearly twenty years when the Captain took his tow through Meldahl in 1974.

Navigation on the Ohio River and its tributaries had been revolutionized in the years since the Captain’s forefathers had piloted on the Ohio, Muskingum, Kanawha, Little Kanawha, and Big Sandy rivers. For the most part, commercial navigation had ended on all those streams except the Ohio and Kanawha, and the Chanoine wicket dams were gone from the Kanawha and fast disappearing from the Ohio. During the second and third quarters of the twentieth century, a “riverine revolution” had drastically altered the character of waterborne commerce.

It could be argued that the riverine revolution began about 1925; at least, the Army Engineers recognized the changing character of waterways navigation in that year. General Edgar Jadwin, Chief of Engineers, recommended in 1925 that obsolete, uneconomical waterway projects be abandoned. “The day of the small, slow, mechanically inefficient and seasonally operated waterway carrier serving a strictly local territory is passing,” General Jadwin said. “It’s place is being taken, on one hand, by railroads and trucks, and, on the other hand, by large and efficiently designed water carriers, operating regularly to important centers of distribution, on channels maintained throughout the year or throughout the navigation season.”


Locking Through
PLAY SAFE JUST PEEK INSIDE FIRST
CAP
T
THINGS YOU SHOULD KNOW IF YOU USE NAVIGATION LOCKS
U. S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
502 8TH STREET
HUNTINGTON, WEST VIRGINIA 25721

Informative booklet on locking procedures available with the navigation charts.

Closing the Obsolete

Sometimes for sentimental reasons, sometimes in the hope that commerce might by chance revive, and sometimes because genuine support for improving and modernizing old projects to permit use by barge tows existed, great public opposition was vigorously expressed each time the Engineers proposed to abandon an old navigation project. Even the open-channel Guyandotte River project, where work had ended in 1899, had its defenders. The Barboursville Chamber of Commerce in 1925 urged further improvement of Guyandotte navigation, and the manager of the International Nickel plant near the mouth of the river protested the abandonment of the Guyandotte navigation project because, he said, the company was influenced in the selection of the location for its plant because the Ohio was navigable all year and the Guyandotte gave the company an outlet to the Ohio. These arguments did not save the Guyandotte navigation project, but stronger arguments were available to proponents of the slackwater projects on the Muskingum, Little Kanawha, and Big Sandy rivers.

Because railroads paralleled Tug and Levisa forks of Big Sandy, the slackwater navigation project—three locks and needle dams on the main stem and one on each of the forks—had never been much used. Commerce on the Big Sandy, except for floated logs, was limited in 1925 to the pool of Lock and Dam 1 near the mouth of the river. But when the Engineers recommended that the project be abandoned there was a storm of protest. Congressman Fred M. Vinson of Louisa, who subsequently became Chief Justice of the United States Supreme Court, published a pamphlet in 1925 entitled *Protest Against the*

Abandonment of the Big Sandy River Improvement, and in his campaign to save the project found support from coal mine operators along the two forks who asserted they would ship coal by river if slackwater were extended upstream to the coalfield.

Vehement and vocal public opposition in 1925 prevented abandonment of the project and the Big Sandy locks and dams were operated intermittently until the end of World War II, when mining and business interests along the Big Sandy and its forks again launched a campaign to gain congressional approval for modernization. The Big Sandy Valley Association of Pikeville, Ky. announced that its objective was nothing less than converting Pikeville and Williamson into seaports! Congressman Carl D. Perkins of Kentucky argued that the Big Sandy coal industry was much hampered in its markets by the lack of waterway transportation. "The economic salvation of the Big Sandy Valley depends to a great degree on the success of this project," the Congressman asserted.

Colonel Harry Pockras and the Huntington Engineers made detailed feasibility studies of new locks and dams on the Sandy and its forks during the late years of the war, and in 1946 he reported that slackwater navigation to the coalfield could be furnished by construction of two new locks and dams on the main stream and four on each of the forks large enough to handle small coal tows.

The Pockras report generated a battle royal at hearings before the House Rivers and Harbors Committee in 1946 and again in 1949. In general, railroads and railroad unions opposed modernization of Sandy navigation, and waterway interests supported it; coal mine operators and miners unions in the Sandy basin favored the project, while operators and unions in other fields opposed it. Colonel Pockras told the House Committee the proposed modernization appeared to. have a favorable benefit-cost ratio for commercial navigation, could revolutionize Big Sandy coal mining and stimulate related economic activities, and could have important military value in time of war when railroads were overtaxed. But while debates on the project were in progress from 1946 to 1950, construction costs nearly doubled, without a corresponding increase in expected project benefits, and in 1950 the Engineers declared the Big Sandy modernization had become uneconomical.

The Huntington Engineers suspended locking services on the Big Sandy River in 1951 and 1952. Dam 1 continued in operation because the Ashland Oil Company paid the costs to furnish water up to its refinery a few miles above the dam, and ownership of Dam 3 at Louisa, Ky. and Fort Gay, W. Va. was turned over in 1960 to the local communities for water supply usė and recreational purposes, but big Sandy navigation and the dream of Benjamin F. Thomas was finally and officially dead. Navigation on the Big Sandy was limited in 1976 to the slackwater provided by the pool of Greenup Locks and Dam on the Ohio, placed in operation in 1962.

The story of the decline of commerce on the Little Kanawha River was similar to that on the Big Sandy. Some support for extending the Little Kanawha slackwater project up to the coalfield continued well into the twentieth century, but traffic on the river dwindled and disappeared as railroads and improved highways were built to serve the area. The Little Kanawha gasboats ceased their service to the upper valley, and by 1941 the only traffic on the river was in the pool of Lock and Dam 1 near Parkersburg. The Engineers suspended locking and maintenance services in 1951, the lock chambers filled with mud, and the dams were breached. Dam 1 was rebuilt and maintained by American Viscose Corporation for water supply; and in 1958 and 1959 the Engineers built a new dam at the site of old No. 3 for water supply and turned what remained of the Little Kanawha navigation project over to the state of West Virginia. Little Kanawha navigation was relegated to the pages of the *S & D Reflector* and other historical journals, and by 1976 most people would be incredulous if told that steamboats once plied the Little Kanawha up to Glenville (104 miles above the mouth of the stream).

Because of the sand and gravel business and a coaltowing movement to a steam-electric plant at Philo, Ohio, gas and dieselboats pushing small barges had for many years a substantial trade on the Muskingum River. The coal traffic came to an end in 1945, however, with the depletion of the river-accessible mine from which the Ohio Power Company had drawn its river shipments. In 1932 and 1942 the Huntington Engineers had studied a plan to modernize Muskingum navigation and even extend it up the Tuscarawas River to Massillon, but estimated costs had far exceeded potential benefits and there was little public interest in any improvement to Muskingum navigation.

Operation of the locks and dams after 1947 was intermittent. In 1952 Dam 10 failed and the Engineers discontinued operation of all facilities except Lock 1, the Merrill "hour-glass" lock at Marietta. Service ended at No. 1 in 1954, and in 1957 when the vessel *Lady Grace* passed through it was necessary to use winches and lines because the chamber was mud filled.

The United States finally disposed of the "white elephant" in 1958 by paying Ohio $235,000—what it would have cost to breach the dams and restore the stream to its natural condition—to take the locks and dams back and maintain them. The last official report of the Huntington District on the Muskingum navigation project, printed in the Report of the Chief of Engineers for 1959, declared with what might have been a sigh of relief: "The work under this project is complete."

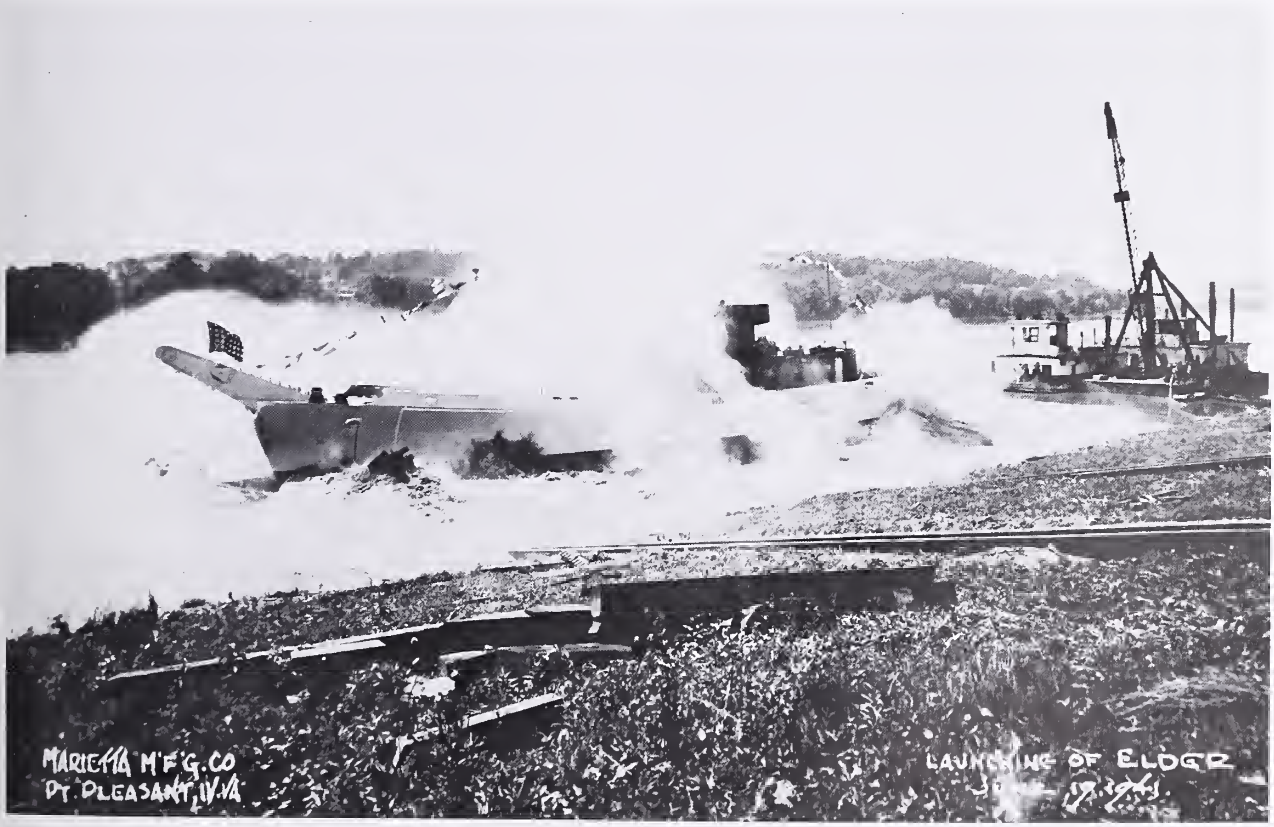
Dam 1 at Marietta was removed at the completion of Belleville Locks and Dam on the Ohio, because the deeper Belleville pool furnished slackwater up the Muskingum to Dam 2. In 1971 the Ohio Department of Natural Resources began restoration of the remaining locks and dams to open the stream for pleasure boats. Fishing and pleasure boating were perhaps not as exciting as the varied uses by flatboats, keelboats, sailing ships, and steam packets, but the river was still used.

Kanawha System Goes through Cycle

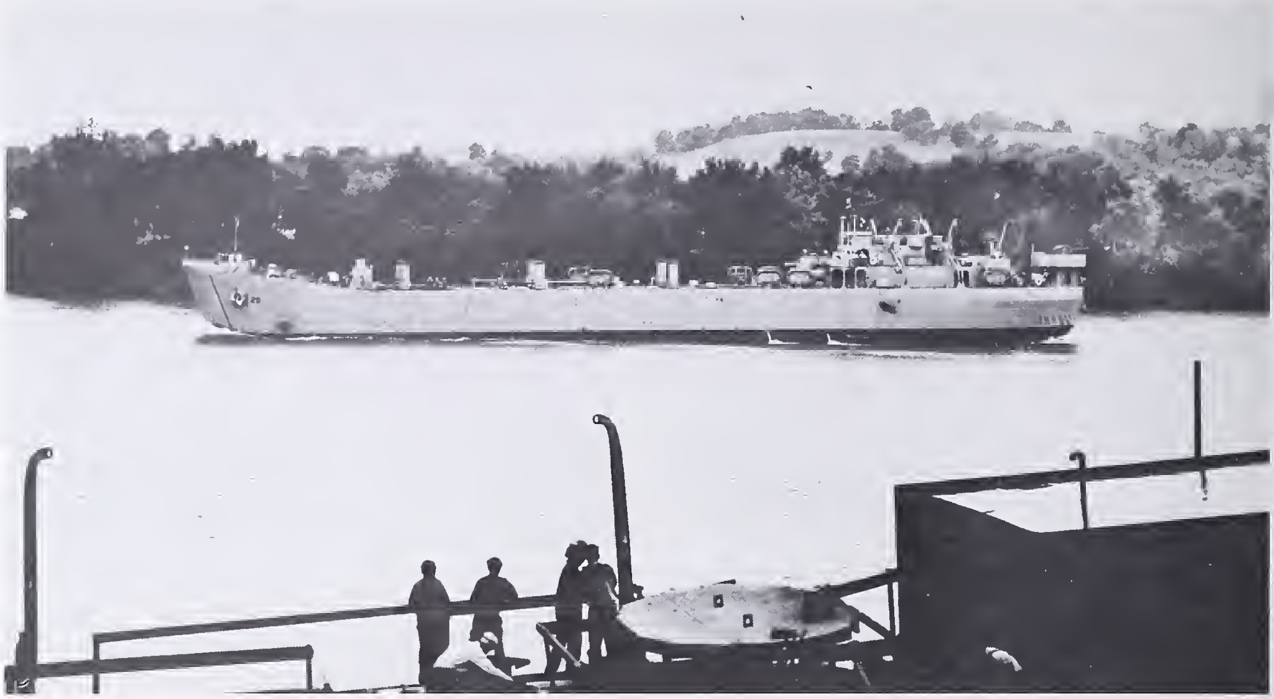
The course of commerce on the Kanawha and Ohio rivers was quite the reverse of that on the Big Sandy, Little Kanawha, and Muskingum. The Kanawha modernization project—the building of Marmet, London, Winfield, and Gallipolis locks and dams—had been approved in 1931 on the basis of traffic forecast to rise to 2,300,000 tons. Commerce on the Kanawha in 1950, twelve years after the roller dams and twin locks were completed, had soared to 6,388,000 tons and was continuing to rise. The Kanawha coal and chemical industries thrived, and a wide variety of commodities—coal, chemicals, acids, gasoline and oil, sand and gravel continued to be shipped—via Addison Scott's river. In 1971, the Kanawha River Basin Committee, which was studying future water needs in the region, asserted that water transportation had played a vital role in attracting new industry to the valley, that the new industry had widely used the river for transportation, and that, because of rapid traffic growth, Winfield Locks and Dam, the lowermost of the three structures located on the Kanawha, was fast approaching the limits of its capacity and would soon require modernization or replacement.

Ohio River Meets Wartime Needs

The Ohio River participated most substantially



Launching of Mine Layer, "Elder," at Marietta Manufacturing Company, Point Pleasant, West Virginia. The Elder and fifteen others were taken to the Gulf of Mexico on their way to World War II action.



Landing Ship, Tank; LST #29, built at Marietta Manufacturing Company, Point Pleasant, West Virginia, one of the 585 sailed down the Ohio and Mississippi Rivers during World War II.

in the riverine revolution. After steady growth during the depression years of the 1930's, waterborne commerce on the Ohio jumped sharply during the war years. With pipelines and railroads working at full capacity and oceangoing tankers being torpedoed at sea by enemy submarines, the American petroleum industry moved to the inland rivers, sending the equivalent of seven million tank car loads of petroleum products in barges up the Mississippi and Ohio rivers for transshipment to eastern terminals.

Because seaboard shipyards were jammed with the construction of the larger ocean vessels, shipyards on the Ohio River and tributaries produced over a thousand smaller vessels for military use during the Second World War. These included 585 LST's, 74 LCT's, 47 tugboats, 36 patrol cruisers, and 16 minelayers, most of them with drafts exceeding the nine-foot depth furnished by the wicket dams. The Engineers got the ships to the Gulf and on the way to overseas action by dropping the Ohio River dams to create artificial navigation surges.

Thirty-eight million tons of commodities vital to the war effort traveled the Ohio in 1942, the peak year of wartime commerce. Traffic dropped back to 33 million tons in 1945, then growth resumed, climbing to 43 million tons by 1950—this on a system of locks and dams planned in 1910 to handle 13 million tons annually. Tonnage on the Ohio actually doubled at approximately eleven-year intervals after the canalization project was completed in 1929; and the predominantly one-way downbound commerce of the pre-1929 era was replaced by a more or less balanced two-way traffic. Giant tows were straining the capacity of the 600-foot locks and the wicket dams by 1950. Double lockage had become common, and the fantastic possibility that traffic would exceed the sheer physical capability of the old locks and dams became a specter looming on the immediate horizon.

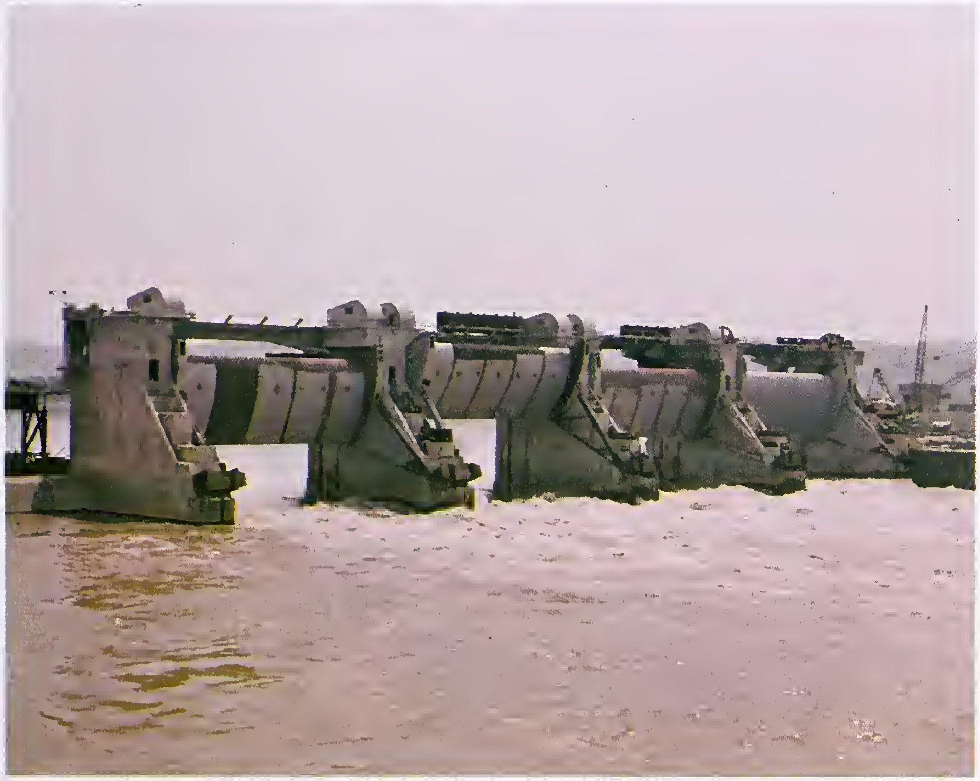
Modernizing the Ohio Waterway

The Engineers began planning modernization of Ohio River navigation about 1950. Fifteen new dual locks and high-lift dams, with an average lift of 23 feet, were planned to replace the old single locks and wicket dams that had an average lift of only 9.5 feet. Higher lifts meant that fewer locks and dams would have to be built, that longer slackwater pools would be provided, and that the traveltime of traffic on the river could be nearly halved. Because the downbound traffic for which the wicket dams had been designed was nearly equalled by upbound traffic in 1950, and because the growing cities and expanding industry at riverside needed more reliable water supply and water oriented recreation, the Engineers decided to dispense with movable-wicket dams in favor of high-lift, nonnavigable gated dams. High-lift dams could furnish longer and deeper pools, and the gates could be opened at floodtime to pass river discharge without significantly affecting flood stages.

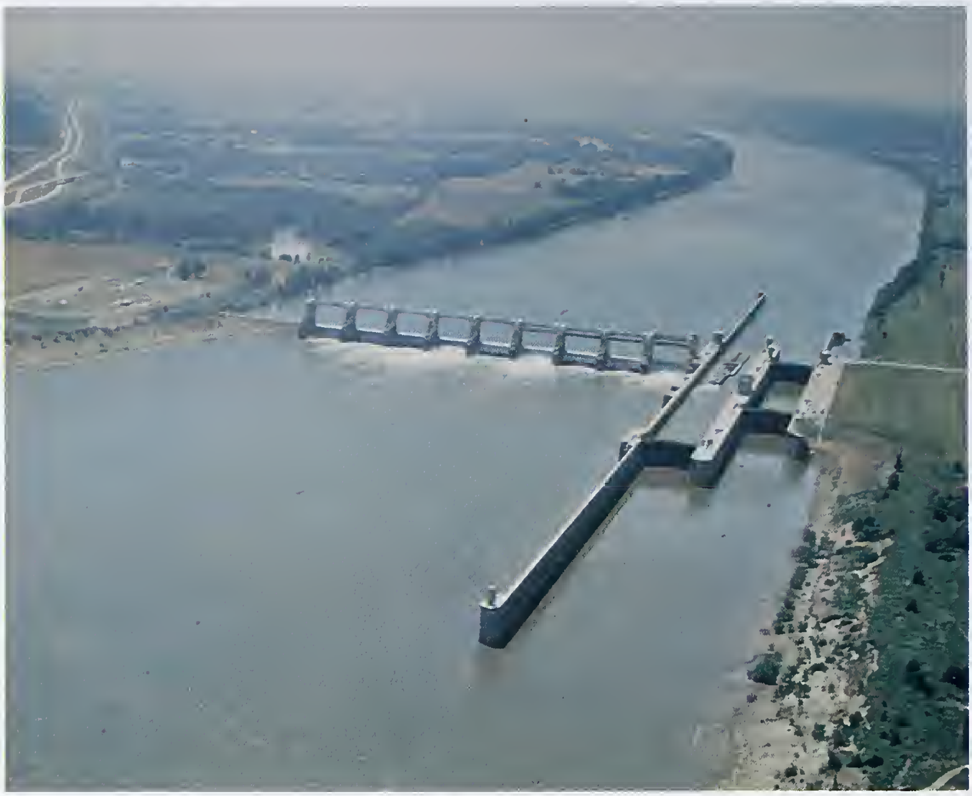
After study of different dam types, modified tainter gates were adopted for the new Ohio River dams. Two Wisconsin loggers, Jeremiah B. Tainter and Thomas Parker, had invented the Tainter segmental gate about 1880 for use in opening and closing dams built for the logging and lumber industry. Tainter patented the gate in 1886, and the Army Engineers bought his rights and built small tainter gates on the Fox River and the Illinois and Mississippi Canal during the 1890's. The modified tainter gates adopted for the Ohio River project were to be mounted between piers of the dams and so designed that they could be pivoted and raised to clear the highest floods of record. Tainter gates up to 42 feet high and 110 feet long were built for the Ohio River dams.

The Merrill locks designed for Davis Island Dam in 1875 were 110 feet wide and 600 feet long, far too short to handle 1,000-foot tows. Plans were made for each of the new dams on the Ohio to have a 110- by 1,200-foot lock and, because the new gated, nonnavigable dams would require all traffic to lock through, an auxiliary 110- by 600-foot lock. The smaller lock would pass traffic at times when the larger lock was being repaired and also handle boats without tows and small craft; the larger lock would pass barge tows of the size operating most efficiently on the Ohio River. Floating mooring bitts in lockwall recesses would permit easier, safer lockage; and a rapid filling and emptying system, emptying under the lock riverwall instead of into the lower lock approach, would speed traffic and also reduce turbulence below the locks.

When construction of the Ohio River Modernization Program was begun in 1954, traffic on the stream had reached more than seventy-one million tons, moving an average distance of 208 miles, and ton-mileage had climbed to nearly fifteen billion. Tonnage was increasing about 15 percent annually and ton-mileage even more. The Engineers hoped to complete the modernization in twenty years if the work were adequately funded. Construction of three of the new structures—New Cumberland, Pike Island, and Hannibal locks and dams—was assigned to Pittsburgh Engineer District. Huntington District was made responsible for building Willow Island, Belleville, Racine, Greenup, and New Richmond (Captain Anthony Meldahl) locks and



Installation of tainter gates during the construction of Greenup Locks and Dam.



Greenup Locks and Dam, the first modern high lift dam with dual locking system to be constructed in the Huntington District.

dams and improvement of Gallipolis Locks and Dam. Louisville District was assigned the Markland, Smithland, Cannelton, Newburgh, Uniontown, and Mound City locks and dams, and improvement of McAlpine Locks and Dam.

Greenup Pool Given Priority

Priority was given to river sections where traffic was heaviest, and this policy led to the selection of Greenup Locks and Dam for first construction in the Huntington District. The Greenup project was so located that its pool would serve the port of Huntington, which in 1953 had surpassed Pittsburgh as the busiest port on the inland streams. Coal by the millions of tons was moving by rail out of the mountains of West Virginia and Kentucky to Huntington, where it was dropped into barges for delivery to Ohio valley manufacturing and steam-electric powerplants. Traffic through the port of Huntington grew from 5.7 million tons in 1949 to 14.5 million tons in 1963 and 23 million tons in 1971. In 1974, the port handled 12 million tons, mostly coal, coke, petroleum, and petroleum products. The Greenup Locks and Dam would replace old locks and dams 27, 28, 29, and 30, providing a deep, clear channel for the bustling port of Huntington and for the other ports of the Tri-State area.

Dravo Corporation began construction of the cellular cofferdam at the Greenup locksite in 1954. Cellular cofferdams, built of interlocking steel sheetpiles driven to foundation rock and filled with dredged materials, had been devised by the Corps of Engineers in 1911 to permit the raising of the battleship *Maine* from the floor of Havana harbor. Celluar cofferdams had been used in building Dams 23 and 32 on the Ohio River during the 1920's, but the Engineers believed the simple wooden Ohio River box-type cofferdam was more economical for low-lift structures. After 1930, however, steel-pile cofferdams were used at most river channel projects, because they could withstand a higher head and allow work to continue inside the coffer for longer periods.

Under the local supervision of Resident Engineers William D. Nowlin and Ralph P. Davis of Huntington District, construction of Greenup Locks and Dam proceeded on schedule except for the interruptions of floods, which covered the worksite five times, despite the protection afforded by high steel-cell coffers. The 1,200- and 600-foot locks at Greenup had hydraulically-operated, steel mitering gates and a system of culverts and laterals capable of filling or emptying the lock chambers in eight minutes. Atop the Greenup Dam sill, nine 37- by 100-foot tainter gates were mounted between piers, each raised or lowered by individual electrically-operated cable hoists capable of pulling the gates up to a point about five feet above the height of the flood of record. Some of the tainter gates were also submergible, in order that ice and drift might be easily passed. The 30-foot lift of Greenup Locks and Dam established a sixty-two-mile-long pool, extending upstream to Gallipolis Locks and Dam, and, by eliminating old Locks and Dams 27, 28, 29, and 30, reduced the number of lockages from four to one and grouped the ports of Huntington, Ashland, and Ironton in the same pool. The 1,200-foot lock could pass in a single lockage a tow consisting of one towboat and twenty-two standard barges transporting about 20,000 tons, with major savings for navigation and ultimately for consumers.

The first traffic through Greenup Lock was an Engineer rowboat piloted by William F. "Bill" McCraw and powered by Gene Corn and Gary Hughes, who rowed through the lock at flood stage on May 7, 1958. Because of swift currents between the locks and the partially completed dam, the towboat *Bob Benter* was permitted to pass through the locks on November 27, 1959. Four old locks and dams, plus Lock and Dam 1 on the Big Sandy, were to be submerged by the Greenup pool and had to be blasted out. Locks 29 and 30, near Ashland and Greenup, were removed by an Army Engineer demolition team from the Fort Belvoir Engineer School that seized the opportunity to test underwater demolition practices; the other three dams were removed under contract by Dravo Corporation. With the channel clear and the structure completed, the Greenup project was dedicated by Secretary of Commerce Luther H. Hodges in ceremonies on July 22, 1962.

Typical wicket dam replaced by the high lift system at old Lock and Dam No. 28, North Kenova, Ohio, 1932.

Meldahl and Other Replacement Pools

After Greenup was well underway, the Huntington Engineers in 1958 began building New Richmond Locks and Dam, later renamed Captain Anthony Meldahl Locks and Dam as a tribute to all rivermen. Meldahl was similar to the Greenup project, but, being located ninety-five miles below Greenup at the lower end of Huntington District, the dam was 500 feet longer. Meldahl replaced old locks and dams 31, 32, 33, and 34, had the standard 1,200- and 600-foot locks, and had a 1,600-foot-long concrete nonnavigable dam surmounted by twelve steel tainter gates between thirteen piers.

Two resident engineers, William D. Nowlin and Robert L. Ledford, died during the construction of Meldahl and were succeeded by Bill McCraw. The construction of Meldahl was delayed by the usual floods and also gained the dubious distinction of being the only Engineer project ever delayed by insects. Locusts by the millions descended on the Meldahl worksite in 1963, scraping up a horrendous racket, aggravating the workmen, and covering the project with their greasy exudations. The bugs died in such numbers that bulldozers were used to shove them into piles, and the resulting stench became intolerable. The Meldahl project was shut down for a week while the worksite was sterilized. McCraw recalled the locust incident with some amusement in 1974, but his nose twitched at the memory.

Nearly a million cubic yards of concrete, 12 million pounds of reinforcing steel, and 35 million pounds of structural steel went into Meldahl Locks and Dam during the seven years of construction, and for seven years the Engineers put their lives into it. The resident engineer wrote: "Ideas, dreams, visions, plans, studies, designs—all these are part of the early stages of any material accomplishment, yet you wonder if one really considers all that must go into the total overall effort that lies between conception of a plan and its ultimate completion . . . . At various times we lived with it, were proud of it, were ashamed of it, loved working on it, hated the

Looking through the 1200 foot lock chamber at Greenup Locks and Dam.

Captain Anthony Meldahl.

sight of it, wished it would last forever, were sorry we had ever seen it, but above all were part of it."

At last, on May 22, 1965, eleven-year-old "Tony" Meldahl, a great-great-nephew of the famed river captain, cut the ribbon that officially opened the Meldahl project and its ninety-five-mile-long pool that provided 21,700 acres of open slackwater for pleasure boats and commercial navigation.

Charles L. "Shag" Hawkins was resident engineer for the Huntington District at Belleville Locks and Dam, begun in 1962 and completed in 1969. The concrete poured at Belleville in a single day was sufficient to pave a mile of city street, and there were carpenters enough on the job to build ten six-room houses in a day. Hundreds of men labored at Belleville on three shifts daily, six days a week, performing carpentry and metalwork in daylight hours and concentrating on concrete pouring under bright lights at night. The reinforcing steel bars placed in the concrete at Belleville weighed 6,930 tons—enough to build three Navy destroyers—which was not overly impressive in view of the fact that the 1,200-foot lock was long enough, though by no means deep enough, to accommodate the Aircraft Carrier *Yorktown*.

On April 15, 1964, while Belleville locks were under construction, Resident Engineer Hawkins saw smoke billowing from a wall of fire blazing across the fields and heading directly toward Reedsville, Ohio, a construction boomtown near the locks. Reedsville quickly became a madhouse, with fire engines and firemen rushing to the scene from nearby towns and workmen and Engineer inspectors from the Belleville project joining the firefight. "Red" Howard, superintendent of the Belleville Locks project for Dravo Corporation, rushed his bulldozers, graders, and end loaders into Reedsville to cut a fire trail between the town and the brush fire. This permitted the firemen to backfire an area to cut off the blaze before it destroyed the town. Fires, locusts, and floods, floods, floods—work at Engineer projects is seldom dull for long.

Lockmaster Cecil A. "Buck" Hale locked the towboat *Western*, pushing eighteen barges filled with a cargo of petroleum, pipe, and turbogenerators, through Belleville on October 13, 1965, before the dam was completed—Dorsal Reible, the Reedsville postmaster, cut the official ribbon while spectators applauded. The dam, establishing a forty-two-mile pool, was finished in 1969, and Ohio River Locks and Dams 18, 19, and 20, plus Dam 1 on the Little Kanawha and Dam 1 on the Muskingum, were removed. Congressman Clarence E. Miller of Lancaster, Ohio, officially dedicated the Belleville project on October 5, 1969.

Racine Locks and Dam, between the Belleville and Gallipolis dams, was the fourth of the series of modern navigation structures built in Huntington District. Bill McCraw, resident engineer at Meldahl, moved upstream to direct construction at Racine in 1966. The Racine project, replacing old Locks and Dams 21, 22, and 23, was very similar to Greenup, Meldahl, and Belleville Locks and Dams, having dual locks and a non-navigable dam with eight tainter gates mounted between nine piers.

Construction of Willow Island Locks and Dam, the fifth and latest of the modernization structures to be built in Huntington District, began in October 1968. Highway relocation in the pool area began in 1967; and, in a report reminiscent of those made by Addison M. Scott on the old Kanawha River project, Office Engineer Robert W. Sheldon wrote: "Work has been plagued from the start with rain, high water, and wet materials. The wet conditions, along with a six-week strike by the operating engineers union, has put the work well behind the originally scheduled completion date." Funding of the Willow Island project was also curtailed, and the Engineers were forced to delay its completion until 1976. This was at great cost to the users, for traffic was

Willow Island Locks and Dam, above Marietta, Ohio, during construction—the last of the high lift structures in the Huntington District.

Gallipolis Locks and Dam under construction, July, 1936.

piling up at the old locks and dams that Willow Island was to replace. Modern barge tows cost up to $200 an hour to operate and delays at the old locks could thus be substantial.

It was evident in 1974 that the Ohio River Modernization Program would not be completed within the twenty-year schedule hoped for in 1954. Senator Allen J. Ellender of Louisiana, noting the rising traffic congestion and tonnage on the Ohio River commented he deeply regretted that:

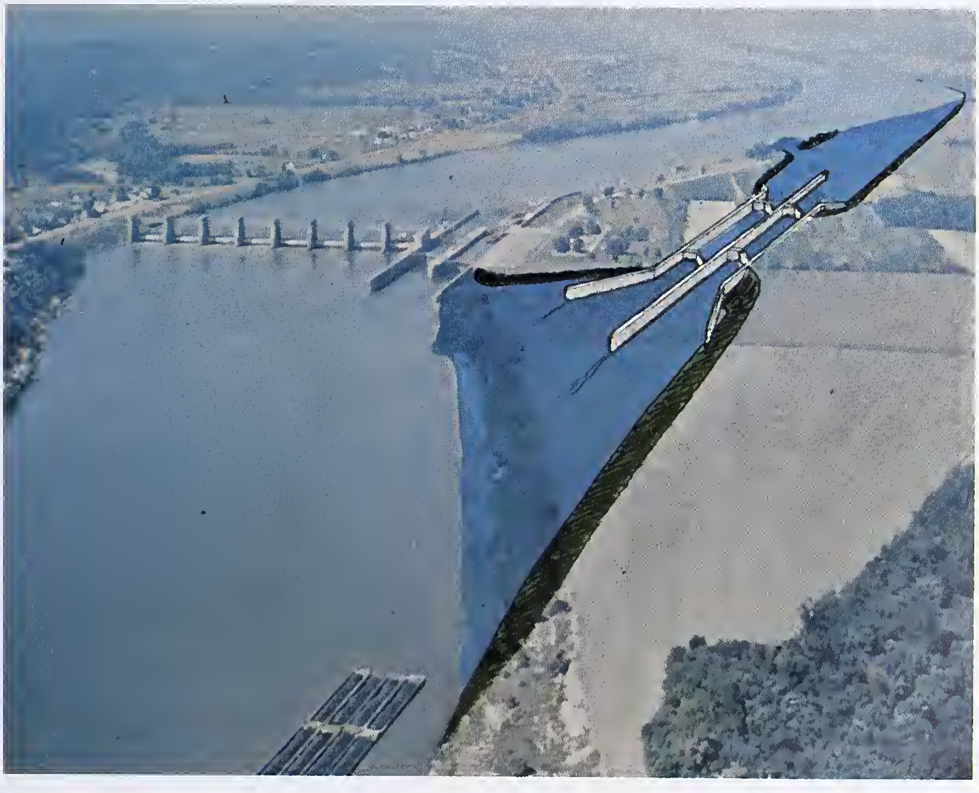
> We [Congress] did not pursue the orderly procedure that we started on this replacement program . . . . If you recall every year we added one new construction start without a budget estimate. My recollection is that we have provided for the construction or replacement planning of 15 of them, and now, because of the budgetary situation, why we have not been able to do that. This program should be completed as soon as possible, because I think it is essential if we are to maintain our economic growth.

But in 1976 Willow Island Locks was completed, and five of the six needed in Huntington District were open to navigation. Great progress had similarly been made in the upstream Pittsburgh Engineer District and the downstream Louisville Engineer District.

Gallipolis: the Final Element

Colonel Kenneth McIntyre, Huntington District Engineer, told the Ohio Valley Improvement Association convention in 1973 that the most critical navigation project remaining in Huntington District was the renovation of Gallipolis Locks and Dam. The thirty-five-year-old Gallipolis project needed extensive repairs, and traffic through the locks was being held up while urgent repairs were made. During a one-week repair period in 1973, ninety-two tows were so delayed—the last to pass had been held up 104 hours. Because the approaches to Gallipolis Locks were more hazardous than those at the new locks and dams, over half the navigation accidents in the District occurred at Gallipolis. When Gallipolis was opened in 1937, it handled only 5 million tons of traffic; by 1967 it was handling about 27 million tons; and it was expected that its physical capacity would be reached by about 1990.

Two solutions to the bottleneck at Gallipolis were proposed: one involved building new locks



Conception of the new canal type locks proposed to upgrade Gallipolis Locks and Dam.

and a new dam about three miles below the old locks and dam; the other called for excavating a canal with new twin 1,200-foot locks around the old dam on the West Virginia side of the river. In early 1974, after study of both proposed solutions, utilizing experimentation with models, the canal with twin locks plan was selected as the most economical of the two and the plan that could be most expeditiously accomplished. Construction of this last element of the Navigation Modernization Program in the Huntington District could begin as early as 1979-80.

Operating the New Locks and Dams

Operation of the new locks and dams differed greatly in detail from the operation of the old, though in basic principle they continued the same. Lockforces at the new structures ranged from thirteen to seventeen men, which was about the same number as were required at the old, but this represented a reduction in total operating force, because one new lock structure replaced three or four of the old. The personnel manning the new structures was subject to fewer personal risks and had greater comforts. The men no longer had to go boating amidst ice floes to raise and lower beartraps and wickets; floating mooring bitts ended the need for men standing on narrow lockwalls to handle lines; and the new operations buildings had elevators and kitchenettes. On the other hand, keeping all the electric motors and the complex machinery of the new locks and dams in proper working order was a formidable task, requiring skills not required at the old structures. And there was still the daily round-the-clock grind of keeping traffic flowing smoothly. At the old locks, in the early days, however, the operators often had time between lockages to mow the lock reservation lawns, or even tend gardens. The new locks were in near constant use and there was little time for the easy going pleasantries that once broke the monotony of the working day.

Lockmaster Woodie Walden, who began work with the Engineers in 1919, served as lockmaster at old Lock 32, and became lockmaster at the huge Meldahl project in 1962, recalled that at the old locks, "We let any type of boat through, from big commercial barges to a guy in a canoe. Once

CORPS OF ENGINEERS
HUNTINGTON DISTRICT

Locking through at Belleville Locks and Dam, completed in 1969.

during the days of the low-level locks I let a guy pass who was swimming from Pittsburgh to Cairo." It would be hazardous to lock a swimmer through Meldahl, but all types of boats were still locked through, with courtesy, provided safety regulations were observed. The standard 1200-foot locks can be filled in eight minutes with enough water to supply a city of 100,000 people for more than two days—they are the same width as the locks of the Panama Canal and 200 feet longer—but the largest of towboats or a skiff can be locked through with equal ease.

Factors in the Riverine Revolution

The riverine revolution experienced on the Ohio River since the end of World War II had multiple causes, not the least of which was the channel improvements made by the Engineers. Twin- and triple-screw diesel towboats, with four or five times greater power than steamboats, reduced the operating costs. Standard welded steel barges, and integrated barges, having hundreds of variations devised for handling special cargoes, increased the life, adaptability, and capacity of barges. Tows of as many as twenty-two standard barges, with maneuvering ability increased by bow thrusters, permitted single towboats to move 20,000 tons comparing favorably with the loading of some of the larger Chessie System coal trains. Radar, developed for military purposes in wartime, has had a marvelous peacetime application, allowing twenty-four-hour operation of towboats, even in fog. Mechanized barge terminals permitted easier and quicker loading and unloading. In short, complex developments in marine design and technology and deeper, longer, slackwater pools made barge towing more economical than any other type of freight movement, except aboard the enormous vessels plying the Great Lakes.

In large measure, economical waterway transportation generated the economic and industrial resurgence of the Ohio valley in the postwar years by attracting plants for the production of primary materials to riverside. Aluminum plants, for example, began locating in the Ohio valley just after 1945 to take advantage of convenient and plentiful water supply, electric power produced at riverside steam-electric plants, and cheap waterway transport. River-shipped coal supplied steam-electric powerplants; primary industries used this power and raw materials brought in by river to produce materials basic to other manufacturing; and hundreds of secondary plants converted the primary materials into commodities salable to American consumers. Waterways were the key to the industrial growth of the Ohio valley, proponents of improved waterways argued.

Chairman William J. Hull of the Ohio Valley Improvement Association explained the connection between waterways and industrialization in this way:

> The benefits of this vital artery of commerce through the center of America extend far inland from the river's edge. Low-cost electric power, generated on the river bank from coal delivered by barge, is transmitted for ever-increasing distances at high voltages to distant inland communities. The expanding power-based and water-based industries—steel, aluminum, chemicals, petroleum, and others—provide an abundance of low-cost basic materials for the expansion of innumerable fabricating and consumer goods industries, both near and far, creating jobs and incomes. Industrial expansion raises the taxation base of the river valley States with which to provide schools, hospitals, and roads throughout the State areas. Progressive improvement of highways permits workers in localities remote from the river bank to commute daily to jobs in water-based industries. Waterbased industrial growth generates rail and truck traffic in high-valued products, components, and supplies. The benefits are broadly diffused.

Mr. Hull omitted other factors, like recreation opportunities and dependable water supply, that also influence industrial location; nevertheless, it would be difficult to deny his general thesis in the light of experience in the Ohio valley. There was the hard fact noted by all shippers that the costs of shipping bulky freight by water in 1970 were lower than they had been in 1960, and were considerably lower than by any other transportation method.

One question that interested observers in 1976 was the direction that waterways transportation might take in the future. A light-draft Greek freighter, built in Japan, ascended the Mississippi and Ohio rivers from the Gulf to make a delivery in 1972. Shades of Jonathan Devol! LASH (Lighter Aboard Ship) containerized cargoes were also making news, and in 1973 General Frederick Clarke, Chief of Engineers, speculated that packaged commodities, like the stuffs once shipped aboard steamboat packets, might again be shipped by river, with important transportation savings, reductions in highway traffic, and perhaps cleaner air.

The Midland Canal Dream

And there was another surprising development—renewed interest in the James River and Kanawha Canal concept, which the Huntington Engineers had thought long dead. On a dull day when there were no fires, floods, or locust plagues, the oldtimers in the District used to amuse the forty-year-old youngsters by relating how General Craighill had once made a favorable report on building a canal over and through the Appalachians to Richmond. Hilarious! But in 1969, Monroe Worthington of Wheeling urged that the James River and Kanawha Canal project be reviewed in the light of advanced technology and engineering-construction methods, and Senator Jennings Randolph of West Virginia, chairman of the Senate Committee on Public Works, referred the suggestion to the Chief of Engineers for report.

Mr. Worthington proposed a modern version of the Central Water Line in three sections. The first section would involve canalization of the James River from Richmond to Natural Bridge, overcoming the 540-foot difference in elevation by building nine locks and dams with sixty-foot lifts, with sufficient depth to permit ocean vessels drawing forty-four feet to sail to the crest of the Appalachians. Section two required drilling a 125-foot-diameter tunnel through the mountains from Natural Bridge to Deepwater, W. Va., a distance of ninety-six miles. The 125-foot tunnel diameter would permit establishing a minimum navigable depth of 44 feet for the ocean vessels, with 70-foot clearance above the water level—by building two tunnels instead of one, two-way traffic would be made possible. The third section would require eliminating the three tiny bottlenecks—Marmet, London, and Winfield locks and dams—on the Kanawha, and excavating the river channel to provide a 50-foot depth to Point Pleasant.

It sounded like quite a wild idea, but there was always Charles Ellet and his "insane" flood control reservoir scheme to remember. After all, the development of navigation on the Ohio River was just as wild. What steamboatman of 1829 could have foreseen a day when movable wicket dams would provide a nine-foot depth for navigation from Pittsburgh to Cairo; and what engineer of 1929, except perhaps President Herbert Hoover, could have predicted the construction of navigation projects like Meldahl, Greenup, Racine, Belleville, and Willow Island? General Craighill said in 1874 the Army Engineers could build the Central Water Line Canal, if the American people and Congress wanted it done. The Army Engineers of 1976 could build the "Midland Canal," if the people of the United States wanted it.

Tow pass in the newer, deeper channel of the Ohio River.

Chapter XIII

Flood Control South Of The Ohio

Congressman Andrew Jackson May of Prestonsburg, Ky. knew what caused the floods on the Big Sandy River and its two forks: the railroads. He told the House Flood Control Committee in 1937 that before railroads built into the southern Sandy basin in 1904 as many as twenty steamboats had regularly plied the Big Sandy and Tug and Levisa forks, and the thrashing of their paddlewheels had caused waves that washed out a deep, wide channel to carry floods to the Ohio at Catlettsburg. Then came the railroads. The Big Sandy "batwings" were driven from the river, the Army Engineers stopped clearing away snags, and sediment accumulated behind the snags and gradually filled the channel. By 1937, floods were smashing through Pikeville, Prestonsburg, Paintsville, and Big Sandy valley communities after ordinary rains. The people of the Big Sandy desperately needed flood protection, Congressman May told the Committee, and he and Congressman John W. Flannagan of Virginia fully supported the Engineer plans to build reservoirs for flood control.

The end of steamboating and the Engineer snagging project might indeed have had some influence on Big Sandy floods, but floods had occurred even during the halcyon days of the Big Sandy batwings. The flood in the spring of 1862, which gravely hampered the efforts of Colonel James A. Garfield and a Union army to seize northeast Kentucky from the clutches of the Confederacy, set records that stood until 1957.

Dewey Dam and Lake, one of the first projects authorized for the sole purpose of flood control.

Flood Protection in Levisa Basin

The furious Big Sandy floods had remarkable velocity. Kentucky Geologist Nathaniel S. Shaler said in 1877 that Big Sandy floods were relatively greater than those on other Ohio River tributaries because the stream had many convergent branches with rapid fall and the rocky, mountainous terrain caused swift runoff. Lieutenant Patrick S. Bond of the Engineers was amazed by a flood he witnessed at the mouth of the Big Sandy in July 1905. He said: "The water was churned into a foam and the waves ran high. The drift was carried clear across the Ohio River to the Ohio side. The river, I am told, could plainly be heard at Ashland, over 5 miles away."

Assistant Engineer Benjamin F. Thomas, the Corps' Big Sandy expert, made the first Corps study of Big Sandy floods in 1922. He found that the flood of 1862, which climbed to a 58.5-foot stage at Pikeville, was the highest of record on Levisa Fork and the Big Sandy main stem, but that floods in 1913 and 1918 had established new records on Tug Fork and nearly destroyed Williamson, W. Va.

In 1937 floods did no great damage in the upper Big Sandy basin, though Ohio River high waters caused major losses at Catlettsburg. But as an outcome of the '37 flood the Engineers suggested the building of reservoirs in the Big Sandy basin to reduce Ohio River flood heights and at the same time provide some protection for the people of the Big Sandy valleys. In 1938 Congress authorized four dams for flood control in the Big Sandy basin: Dewey on Johns Creek, Fishtrap on Levisa Fork, Clintwood (Pound) on Pound River, and Haysi on Russell Fork. Preconstruction planning for Dewey Dam and Reservoir in Floyd and Pike counties, Ky., on Johns Creek, a tributary of Levisa Fork, was begun in 1938 and was far along when it was interrupted by the war in 1941. The study was resumed in the late war years, and construction was begun in March 1946.

While planning flood control dams and reservoirs, the Engineers gathered precipitation records and, by combining records of the greatest storms over the valleys, calculated the possible maximum rainfall. Surveys were then made of soil types, topography, ground cover, stream channel slopes, and other factors that might influence the amount of runoff, and, by combining the greatest possible rainfall with conditions favorable to runoff, it was possible to compute the Probable Maximum Flood—that is, an "inundation of biblical proportions," a superflood. The dams, whether constructed of rolled earthfill, rockfill, or concrete, were then designed to store and pass the "superflood," with outlet tunnels to release part of the water and spillways to act as safety valves to prevent water from overtopping the dam if the outlet capacity were exceeded. The estimated Probable Maximum Flood was then used to determine the height of the dams and the size of the outlet works and spillways. Possible earthquake and wave action were also studied in detail, and precise scale models of the structures were built and tested at Engineer hydraulic laboratories. Safety factors have been so well designed into Engineer reservoir projects that no Engineer reservoir has ever failed, and the spillways have rarely been needed.

A guiding principle in Engineer water resources planning was that each project and each part of each project should yield more benefits than the cost of building, operating, and maintaining the project; that is, an estimated benefit-cost (b:c) ratio was calculated for each project. A 1:1 ratio meant that estimated benefits equalled estimated costs; a 2:1 ratio was thought excellent; anything under a 1:1 ratio would not be constructed.

The first flood control reservoirs, such as Dewey on Johns Creek, were authorized, in 1938, for flood control alone. Dewey Dam provided accumulated protection from floods over the expected life of the project so that estimated benefits from "flood damages averted" were greater than the cost of the project.

During the postwar era, however, Congress recognized that reservoirs built chiefly for flood control had many other benefits—recreation, pollution abatement, water supply, fish and wildlife enhancement—and directed the Army Engineers to consider these benefits in planning projects and to compute their contribution to the benefit-cost ratio. The dams and reservoirs built in Huntington District after 1945 were therefore designed to serve multiple purposes, rather than for flood control alone.

Dewey Dam, a 920-foot-long and 118-foot-high earthfill structure with concrete outlet and spillway, was completed in July 1949—the first Engineer reservoir in the Big Sandy basin, and the first flood control reservoir, other than those built on the Muskingum by Zanesville District, completed in Huntington District. During 1950 the Dewey project began paying returns on the investment by controlling severe local flooding after intense rainstorms passed over the basin. the lands around the 16.8-mile-long conservation pool also became the site for a precedent-setting reservoir management program. To serve the thousands who flocked to lakeside to enjoy water sports and outdoor recreation, the commonwealth of Kentucky built recreation facilities at the lake, notably Dewey Lake State Park, later renamed Jenny Wiley State Park to commemorate a Big Sandy heroine of frontier days.

Construction of other flood control reservoirs in the Big Sandy basin was delayed, while the Huntington Engineers concentrated on comple-

Jenny Wiley Lodge, part of the gigantic recreational area in the Jenny Wiley State Park that the State of Kentucky built around Dewey Lake.

tion of high-priority projects in other river basins, until the calamitous flood of January 1957, that exceeded the 1862 record at Pikeville by nearly a foot and ravaged the communities along Levisa Fork. President Dwight D. Eisenhower declared the region a major disaster area, and the Army Engineers and other federal agencies rushed into the area to help clean up the mess. Just after the 1957 flood subsided, delegations of citizens from Dickenson County, Va., and Pike, Floyd, and Johnson counties, Ky., traveled to Washington to plead with Congress for more flood control, and Congress responded by appropriating funds for building Fishtrap and Pound (John W. Flannagan) Dams and by approving the North Fork of Pound River Dam.

John W. Flannagan Dam and Reservoir, nestled in the Cumberland Mountain area of Dickenson County, Va., on Pound River, a tributary of Levisa Fork, was named after the Virginia political leader who had worked unceasingly on behalf of flood control for the Big Sandy basin. Resident Engineer Denver "Denny" J. Shoup of Huntington District directed construction at the site of Flannagan Dam, the highest rockfill dam in Virginia, beginning in February 1960.

Just getting into the Flannagan damsite over the rugged mountain roads was difficult. A supplier of steel girders 86 to 99 feet long for a road bridge tried to move the girders to the job via the narrow, curving roads and finally gave up, saying: "You just can't get there from here with these girders." The contractors finally found a company willing to make the attempt; and with a heavy-duty tandem tractor and steering dolly, plus a truck crane to swing the ends of the girders around hairpin road curves, the girders at last reached the site and were placed in the bridge spanning Cranes Nest River near its confluence with the Pound.

The Flannagan Dam, an imposing 260-foot-high structure with a unique concrete intake tower in octagonal form, was completed in 1965 and dedicated by Congressmen W. Pat Jennings of Virginia and Carl D. Perkins of Kentucky. The dam prevented $15 million in damages in a single flood; its construction cost was only $20 million.

Denny Shoup and the resident project staff at

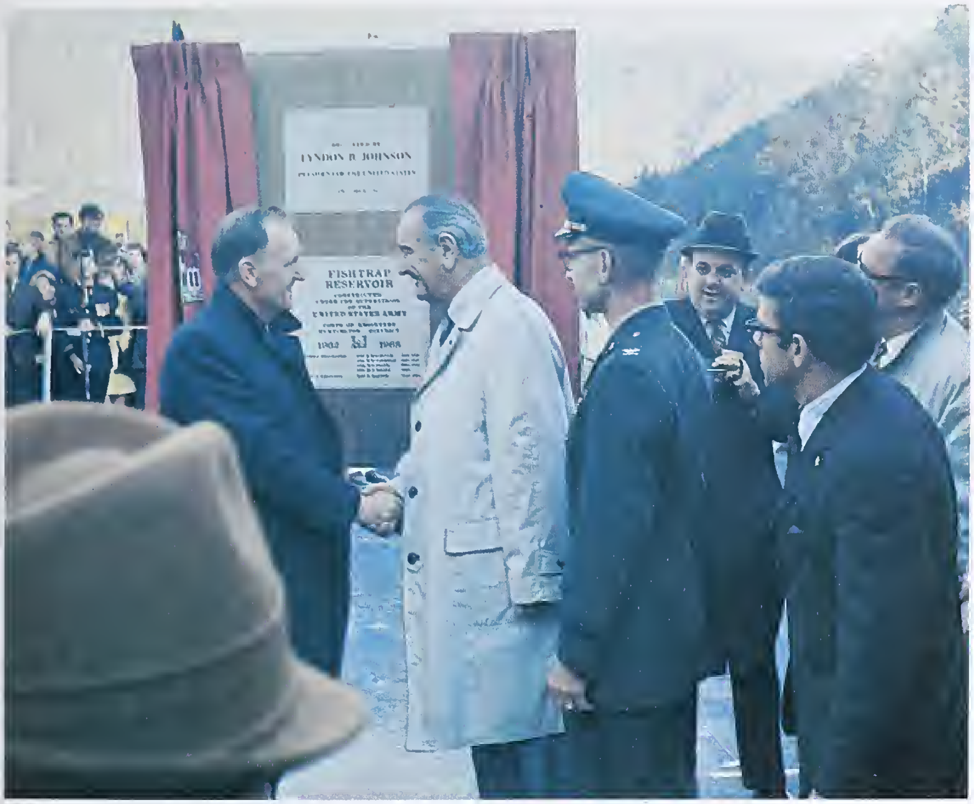
Flannagan Dam also inspected the work of the contractors at the relatively tiny, jewel-like reservoir in Wise County, Virginia on North Fork of Pound River above Flannagan Dam. Authorized by Congress in 1960, North Fork of Pound River Lake was built between 1963 and 1968. The curving rockfill dam, set amidst the verdure of hillside forest, with an outlet tower stabbing the lake, won the coveted Chief of Engineers' Award for engineering-design excellence in 1968, because, the award read, the "strong sculptural form of the tower stands in effective contrast to the naturalistic setting of the reservoir and the curved form of the dam has led to economy of materials without sacrifice of structural safety." This was the first such award won in the Corps' Ohio River Division.

Fishtrap Dam and Lake, named after a nearby community that in turn was named for a rock fishtrap dam built by Indians on Levisa Fork, was constructed under the local direction of Resident Engineer Ray R. Barton of the Huntington District between 1962 and 1968. The dam, built from native rock atop a clay core, required moving five million cubic yards of rock and earth, the construction of intake tower, outlet tunnel, and tainter-gate controlled spillway structure, and extensive highway, railroad, utility, school, and cemetery relocations.

Any construction job involves personal risk for the workmen, with trucks, dozers, graders, and heavy equipment continually crisscrossing the jobsite while cranes and highlines swing heavy concrete buckets and materials dizzily overhead and rocks, stakes, and loose materials litter the ground. Safety records at Engineer projects, both for Corps and contracting personnel, were much improved by the safety campaigns and precautionary measures developed after 1933; nevertheless, the Engineers who supervised work at construction sites could, if they wished describe construction accidents that would shoot the listeners' bloodpressure skyhigh. The Fishtrap project, during its seven-year construction period, cost the lives of three men. This was a small number when compared to the fifty-six lives lost in building Wilson Dam on the Tennessee River in 1925, or the ninety-eight lives snuffed out at the Boulder Dam project on the Colorado River in 1928, but three was still a heavy toll.

Fishtrap Dam, which also won the Chief of Engineers' Engineering-Design Award, was dedicated by President Lyndon B. Johnson, who

John W. Flannagan Dam under construction in 1961, the highest rockfill dam in Virginia.


LYNDON B. JOHNSON
FISHTRAP RESERVOIR
UNITED STATES ARMY
1962
1968

ke County Says Howdy L.B.J
FISHTRAP

President Lyndon B. Johnson attended the Fishtrap Dam and Lake dedication ceremonies and was heartily welcomed by the crowd.

Fishtrap Dam and Lake—built from native rock by moving five million cubic yards of rock and dirt.

landed by helicopter to address the crowd at the damsite on October 26, 1968.

The Huntington Engineers completed a restudy of Big Sandy flood problems in 1964 and recommended construction of three more multipurpose reservoirs: Panther Creek Lake in McDowell County, W. Va., on a tributary of Tug Fork; Yatesville Lake in Lawrence County, Ky., five miles west of Louisa on Blaine Creek, a direct tributary of the Big Sandy; and Paintsville Lake in Johnson and Morgan counties, Ky., on a tributary of Levisa Fork. Planning for these three projects was nearly complete in 1974, land acquisition was underway at two sites, and construction of the Paintsville and Yatesville projects was beginning.

At Prestonsburg and Martin, the Engineers also completed flood protection projects to handle local flooding problems and supplement the protection afforded by reservoirs on Levisa Fork and its tributaries.

At Pikeville, the Huntington District designed the "Pikeville Cut-Through," which was under construction by the commonwealth of Kentucky in 1976. Construction of the Cut-Through, begun with a dynamite blast detonated by Pikeville Mayor W.C. Hambley on November 26, 1973, involved removal of 16 million cubic yards of material, mostly bedrock, in cutting through the neck of an incised meander of Levisa Fork just to the west of the city. It would result in the relocation of the channel of Levisa Fork and parallel highway and railroad line, shortening the stream, the highway, and the railroad by more than two miles, and eliminating all mainstream flooding in Pikesville. It was a part of a cooperative Model City program to revitalize Pikeville and the surrounding area, and would provide space for parks, municipal and commercial buildings, and public housing. It would remove coal-loading facilities from Pikeville and reduce pollution, noise, traffic, and unsightliness within the city.

The flood control reservoirs and local flood protection projects on Levisa Fork supplied major protection for that western section of the Big Sandy basin. Most residents of the Levisa Fork valley were unaware of the great flood of March 1967 because, thanks to the completed projects, there was no major flood—the reservoirs reduced the 1967 flood crest by 8.5 feet, at Pikeville, 7.2 feet at Prestonsburg, 9.2 feet at Paintsville, and 4.7 feet at Louisa.

Reducing Damages along the Tug

Much less had been done to control chronic flooding in the Tug Fork valley, to the east. A channel improvement project was built at Inez, Ky.; floodwalls were built at South Williamson, Ky., and Williamson, W. Va.; the proposed Panther Creek Reservoir was authorized in 1965; and local protection work at Matewan and additional work at Williamson was approved in 1970, but much less progress toward flood control was made along Tug Fork than on Levisa Fork. Colonel Maurice Roush, Huntington District Engineer, in a 1970 report on Tug Fork flood problems, said Tug Fork floods caused damages averaging more than $600,000 annually, that flooding depths were formidable, and that persistent flooding contributed much to depressed economic conditions. Colonel Roush explained:

> The potential for more disastrous floods shrouds most activities with an aura of impending doom. The cumulative effects of the frequent floods are readily apparent. Literally hundreds of dwellings and business structures have been subjected to gross neglect and are either totally dilapidated or rapidly deteriorating. The blight on the aesthetic environment breeds further neglect. Of course, a prime cause of the deterioration is the depressed economy. However, more often than not, the prospect of repeated flooding discourages proper maintenance, and makes repairs to damaged property a futile effort.

Disastrous floods occurred in Tug Fork basin in 1957, 1963, 1967, and 1974, but the construction of Panther Creek Dam was not funded, and a marginal flood control reservoir project on lower Knox Creek was studied but not approved. In the aftermath of the January 1974 flood, however, Tug valley civic and political leaders launched a compaign to gain some degree of flood protection. Bob Hubbard, chairman of the Tug Valley Chamber of Commerce, declared: "It is utterly impossible to live with this situation. We have been polite too long, we have taken a back seat too long. We need action on more flood protection now."

City of Pikeville; Kentucky, showing the Corps designed "Pikeville Cut-Through," part of a cooperative Model City Program to revitalize the area.

Floodwall constructed by the Corps around hospital at South Williamson, Kentucky.

The Water Resources Development Act signed by President Richard M. Nixon on March 7, 1974 authorized additional flood protective measures in Tug Fork basin, but civic leaders in the valley described the bill as only a stopgap measure. Sid Copley of the Tug Valley Chamber of Commerce said: "We need to press on for the construction of reservoirs at Lower Knox Creek and Panther Creek, in order to provide flood protection for the whole area." How much this renewed public support for flood control measures in the Tug Fork region would influence Congress was still subject to speculation in 1976.

Programs for Little Sandy and Tygarts

A few miles below the junction of the Big Sandy with the Ohio River, Little Sandy River and Tygarts Creek emerge from the hills of eastern Kentucky to enter the Ohio. Neither stream ever carried a major waterway commerce, though the Little Sandy was navigable under Kentucky law, and before the Civil War iron was shipped in flatboats down the stream from furnaces and forges owned by William Ward and David Trimble. The contiguous Little Sandy and Tygarts Creek basins were subject to frequent flooding: major floods occurred on the Little Sandy in 1928 and on Tygarts Creek in 1934 and 1948. In their "308 Report" of 1933 on the Ohio River, the Engineers considered possible construction of flood control reservoirs at Argillite on the Little Sandy and near Argentum on Tygarts Creek, but they recommended neither project and nothing was done to protect the two basins until after communities like Grayson and Olive Hill were heavily damaged by floods in September 1950.

Citizens of Boyd, Carter, Greenup, and Elliott counties in the Little Sandy and Tygarts Creek basins went to Congress and federal authorities in the aftermath of the 1950 flood to ask assistance in solving their flood problems. Congress directed the Huntington Engineers to study the situation, and these studies eventually led to the carrying out in the two basins of several flood protective undertakings and the building of a flood control reservoir.

Grahn and Hitchins communities in the Little Sandy basin were protected by channel clearance work—removing snags and obstructions and widening and deepening stream channels—completed in 1964 and 1965. The channel of Tygarts Creek at Olive Hill was cleared and improved in 1959. The Huntington Engineers recommended construction of Grayson Lake on the Little Sandy and Kehoe Lake on Tygarts Creek in 1960, but the Kehoe project was sidelined for restudy because of its marginal economic feasibility.

Dozers and other heavy construction equipment were set to work at the Grayson damsite, on the Little Sandy seven miles south of Grayson, in July 1964, and, under the supervision of Resident Engineers Walter Glasgow, Gaylord Robinette, and Howard K. Crisp, the project was completed in 1968. The 120-foot-high earth-and rockfill dam, built at a cost of $18.2 million, created a twenty-one-mile-long pool bordered at many points by sheer sandstone cliffs partly covered by hemlock trees and green laurel. Visitors were thronging to lakeside to enjoy water sports and the project had already returned major flood control benefits when it was dedicated by Secretary of Agriculture Orville L. Freeman, Congressman Carl D. Perkins, and Lt. Governor Wendell Ford of Kentucky on October 25, 1968.

The Huntington Engineers finished their restudy of Kehoe Lake on Tygarts Creek in 1966 and found the project economically feasible, and that, by providing employment, business opportunities, increased real estate values, and a greater tax base, it could do a great deal to "stimulate economic activity in this part of the Appalachian Region." Kentucky strongly supported the building of the project and agreed to cooperate in the development of recreational facilities. Approval by Congress was given in 1966, but the project plans were later modified after the Environmental Protection Agency concluded that water quality control should not be included as a project purpose, and further approval was thus required. This was given in December 1975, and initial funds for construction were appropriated in 1976.

Control Measures on Twelvepole Creek

By 1976 substantial progress had also been made in controlling floods along Twelvepole Creek and Guyandotte River in western West Virginia. The Guyandotte River, it will be recalled, was once improved for navigation by Colonel William E. Merrill and the Engineers. Twelvepole Creek, which lies between the Big Sandy and Guyandotte basins and joins the Ohio between Huntington and Ceredo, was also used as an avenue to market for log rafts during the nineteenth century, and about 1874 the Twelve Pole River Mining and Navigation Company was organized to build locks and dams on the stream to establish slackwater navigation for small coal barges. Colonel Merrill investigated the Twelvepole slackwater project for the Engineers in 1874, reporting that ten locks and dams could open access to the coalfield, but that during dry

Grayson Lake near Grayson, Kentucky, on the Little Sandy River.

East Lynn Dam and Lake on Twelve Pole Creek, one of the lakes with good recreational facilities in the proximity of Huntington, West Virginia.

seasons streamflow was insufficient for lockage. Colonel Merrill rejected the proposed slackwater project, and nothing was ever done to improve Twelvepole navigation.

"Padre" Merrill also reported in 1874 that Twelvepole Creek was subject to abrupt flash floods, with a remarkable discharge when compared to the ordinary flow of the river. A century later, the Huntington Engineers were building the East Lynn and Beech Fork reservoir projects to control those floods.

East Lynn Lake, on East Fork of Twelvepole Creek, was approved by Congress in 1938, but nothing except planning studies was completed until after 1962, when Congress held hearings on Twelvepole flood problems and regional water development needs. At those hearings, major public support for the East Lynn and Beech Fork projects was expressed. Congressman Ken Hechler of Huntington, for example, told the Committee on Public Works:

> I have been in the flooded areas of Wayne County when Twelvepole Creek has isolated entire areas. I have seen the suffering written on the faces of families made homeless. I have seen the floors of school buildings buckled by the floodwaters. I have seen crops which mean a year's income destroyed by the rampaging waters. I have seen the specter of disease grip a populace. I have seen the economy of an area uprooted. This has been particularly true in the vicinity of East Lynn and Wayne in Wayne County—sturdy communities which have recovered from the blows, but which need and deserve protection for the future.

Congressman Hechler said the East Lynn and Beech Fork reservoirs would supply vital flood control, new employment opportunities, stepped-up industrial potential, and, because of their proximity to the Tri-State urban-industrial area, including Huntington, very high recreational values.

The extent of the recreational use which would be made by fishermen and water sportsmen at the Engineer flood control reservoirs had not been foreseen when the first reservoir projects were authorized, but after World War II, Americans, with more leisure time, greater personal income, and automotive mobility, flocked to the Engineer reservoirs during weekends and holidays like lemmings to the sea. The number of visitors to reservoirs in the Ohio River basin mushroomed from a million in 1950 to 20 million in 1960 and to 68.9 million in 1972. Engineer projects across the nation recorded more than 300 million visitors in 1972, more by far than those of any other federal agency involved in public recreation. And the rate of recreational use of Corps projects was growing at a rate three times the annual increase in the Gross National Product and six times the rate of population growth. In 1962 Congress recognized recreational benefits as a viable reason for building reservoir projects, and established standards for computing the value of recreation on a benefit-cost basis. Benefits for recreation figured high in the justification of the East Lynn and Beech Fork reservoirs.

Senator Jennings Randolph of West Virginia, believing the word "lake" was more closely identified with recreation in most people's minds than "reservoir," sponsored a bill in 1967 that changed the official name of Engineer reservoirs in West Virginia to "lakes." Bluestone Reservoir, on New River, thus became Bluestone Lake. Congress extended this change in nomenclature to the entire nation in 1970, and nearly all Engineer flood control and multipurpose reservoirs became officially designated as "lakes."

Skyrocketing recreational use of Engineer lakes and the related economic activities generated by the thousands of sportsmen and other visitors using the lakes had the effect of breaking up the so-called "upstream versus downstream syndrome" that had always plagued Engineer flood control planning. Many vital flood control reservoir projects were held up prior to 1960 by vehement and organized protests from upstream interests—mostly the people whose homes and property would be bought by the government in the reservoir areas for public use. The downstream interests—the people who would receive benefits from flood protection—countered by organizing groups to support projects. Intravalley struggles for the ears of Congress frequently were acrimonious. The position of the Corps of Engineers on the "upstream versus downstream" controversies was summarized by Huntington District Engineer Maurice Roush in this way:

> Upstream residents who are losing their homes always feel differently about a project than those downstream who will be benefited by flood control and other advantages. I expect opposition, and I don't think it can be ignored. If it is significant enough, the plan may have to be changed or even cancelled. But the Corps does not make these decisions. Congress does. My sympathy is with the person who is hurt in order to benefit others, but his pleas probably won't sway us unless he has a cogent point we had not considered, such as a better place to put the dam.

Real estate acquisition for water projects was the most sensitive, the most thankless, task the Huntington District and every other government agency exercising the power of eminent domain

Recreation scene at East Lynn Lake.

Beech Fork Dam under construction on Twelve Pole Creek south of Huntington.

had to perform. People who saw their family homesteads covered by water, even though they were guaranteed fair market prices for their property and their sacrifice to provide a safer, better life for other people, seldom viewed the taking of their land and homes in the public interest with equanimity. Caustic attacks on the Engineers, springing from the bitterness of landowners are printed regularly, with what seems almost fiendish delight, in the news media. A typical letter of this sort might read:

> The rape of our forests and hillsides has been written about for some time, but nothing much has been said about the most important rape of all, which is that of our mountain people. They are being scattered to the four corners of the world so the corps of engineers and the politicians can make use of their land and property for people to tramp over and to boat, fish, and water ski on the once beautiful streams. Soon we are going to be like the children of Israel, trying to find a place to lay their heads.

By 1962, when funds for East Lynn Dam and Lake were supplied by Congress, though there was some opposition from upstreamers, the downstream interests were finding support from people in the reservoir area who were interested in the economic potential that the growth of recreational use promised.

Resident Engineer David J. Deeds supervised the construction of the East Lynn project, beginning in 1966, from a field office at the site. Ultramodern schoolhouses were built to house pupils who formerly attended school at antiquated buildings in the reservoir area; graves in the reservoir area were removed to a thirteen-acre reinterment cemetery, which was the first in the District to include a speaker's building, picnic tables, and benches for visitors. The Engineers gave all possible assistance to the people displaced by the lake in finding new homes.

A thirteen-foot diameter outlet tunnel, or conduit, was drilled and lined with concrete; the dam foundation was excavated and grouted; a spillway was cut through a ridge to the west of the dam; and the chugging dozers rolled the earth core and rock sections of the dam into place. When Congressman Ken Hechler and District Engineer Kenneth E. McIntyre spoke to the crowd attending the dedication ceremonies on July 14, 1973, the East Lynn project had already prevented about $1.5 million in flood damages and was attracting hordes of sportsmen.

Beech Fork Dam and Lake, authorized in 1962 and located on a tributary of Twelvepole Creek near Huntington, was placed under construction in 1970. The 1,070-foot-long earthfill dam was completed in 1976. The West Virginia Department of Natural Resources was making plans for facilities to serve recreationalists and was seriously considering the building of a state park at the lake.

Building of R.D. Bailey Lake

R.D. Bailey Dam and Lake, in the adjacent Guyandotte watershed, was being built in 1976, with completion scheduled for 1977.

The Guyandotte River had had a long history of flood havoc. A board of Army Engineers examined the stream in 1824 in search of a site for an armory because they had been told of an eighteen-foot waterfall on the river that could furnish power for arms manufacturing. They found, however, that a flood had destroyed the mill at the falls, washed away adjoining bottomlands, and cut a new channel around the falls, leaving them waterless and powerless.

The annual floods on the Guyandotte had once been welcomed—they signaled the beginning of wild log-raft rides to Barboursville, Guyandotte, and Huntington. As mining communities developed in the valley—there was little other land suitable for building—rainstorms and devastating flash floods pouring into the valleys from the steep narrow-crested ridges became a constant menace to towns like Mullens, Man, Logan, Stollings, Chapmanville, and Branchland, which were crowded between the hills.

In 1938 Congress approved the construction of a flood control reservoir on Mud River, a tributary of the Guyandotte, but there was little public interest in the project and it was never built. Too, the city of Mullens, in 1934, with funds from the Works Progress Administration, dredged and widened Slab Fork, a tributary at that community. But not a single other flood protection project existed in the Guyandotte basin when record floods ravaged the narrow valleys in 1957 and 1963.

Just after the 1957 flood disaster, Guyandotte valley civic leaders organized efforts to pressure Congress for action to reduce flood hazards. Congress directed the Engineers to study the situation, and in 1962 the Huntington District recommended construction of Justice Dam and Reservoir (R.D. Bailey Lake). At the hearing on the project before the Senate Committee on Public Works, Mayor Litz McGuire of Logan vividly described the effects of continued flooding in these words:

> When the water comes we have no place to go. Frequently our children don't go to sleep at night. When it rains hard the children will lie

Construction on R. D. Bailey Dam and Appurtenant Works on the Guyan River above Justice, West Virginia.

This scene shows one of the new schools relocated out of the R. D. Bailey project area. This project has involved extensive relocation of railroads, roads, bridges, schools, cemeteries, homes and other facilities.

> awake all night because they are afraid they are going to be washed out. And when we have a lot of rain I do not sleep. And when the water comes up it comes so fast that you can't get your furniture out of the house. I am not going to spend any more money on my home than is essential. Other people are the same way. Industry is the same way. Who is going to invest in something likely to be washed away or ruined?

Congress authorized the Justice project in 1962, but construction was delayed while negotiations with the owners of mineral rights in the reservoir area continued. In March 1963 a flood exceeding previous records at Logan by as much as 3.5 feet caused over $8 million damages in the basin. Valley leaders thereafter pursued the project with renewed vigor. Robert Harris, president of the Logan County Chamber of Commerce, told a House Committee that ever-impending flood threats were driving people out of the valley and discouraging industry. "There is no one single thing that will help us more than this dam," he declared, "for in addition to the flood protection we also realize the tremendous economic importance of the recreational aspects of this project as well as the economic aspects inuring to a guaranteed water supply by the reservoir."

The site of Justice Dam was relocated in 1965 to minimize mineral losses, and Congress funded the work, also renaming the project R.D. Bailey in honor of a prominent Wyoming and Mingo County judge and political leader. Under the local direction of Resident Engineer Gaylord Robinette, construction of the huge Bailey project began. In addition to building the dam, the Bailey project required the acquisition of almost 20,000 acres of land, the relocation of twenty-five miles of railway and thirteen miles of highway, and the relocation of utility lines, two schools, and eighty-four cemeteries containing 2,000 graves. Progress was delayed by presidential orders freezing funds to counter inflation, and the Huntington District was much criticized because of these delays. Congressman Hechler even blamed some of the delay on the District Engineer turnover—Corps policy since the turn of the century had required that Engineer officers have a change of assignment at about three-year intervals. The Congressman pointed out that there had been as many District Engineers at Huntington as floods on the Guyandotte: Colonel H.J. Skidmore initiated the flood protection survey after the 1957 flood and left the District in 1960; Colonel Steven Malevich presented the plans for Bailey Dam, but was gone when the record flood of 1963 hit the valley and was replaced by Colonel Harrington W. Cochran who promised the dam could be finished by 1969; and Colonel Cochran in turn was replaced by Colonel William Falck, who said the dam could be completed by 1973.

Funds for R.D. Bailey Lake were released in 1967, and the first contract, for relocation of Norfolk and Western Railway tracks, was awarded. Federal budgetary "stretch-outs" and other delays still gravely hampered progress, and high water flooded points along the Guyandotte seven times in 1973 and early 1974. Senator Robert C. Byrd of West Virginia said the situation was intolerable and urged a crash program to get the project into operation. The contract for constructing the dam and spillway was at last awarded, to Western Contracting Corporation, in November 1973.

R.D. Bailey Dam, in rugged southern West Virginia, on the Wyoming-Mingo county line, was first planned as a rockfill dam with an impervious clay core. The type clay required for the core was scarce in the area near the dam, however, and, because the environmental damages of digging the clay at several isolated sites might have been high, the Engineers decided to dispense with the clay core and place a concrete mattress on the upstream face of the dam—it would be the first dam of this type built by the Army Engineers.

After completion, Bailey Dam will be able to store more than 60 billion gallons of water, enough to effect major reductions in Guyandotte River flood crests.

Steps in Little Kanawha Flood Protection

The two Kanawhas, Little and Great, that flow across West Virginia to join the Ohio, at Parkersburg and Point Pleasant, have had vastly different flood control histories, much has been done to reduce floods on the "Great" Kanawha and its tributaries, but practically nothing was accomplished on the Little Kanawha before the building of Burnsville Lake was started in 1972.

The Little Kanawha gasboats and most other river commerce were gone when the Huntington District made its "308 Report" on the stream in 1930. The Engineers said that further improvement of Little Kanawha navigation would be ill advised. There were, however, four good sites for multipurpose dams to store floodwaters for release to aid navigation and generate hy-

Burnsville Dam and Lake, the first flood control project on the Little Kanawha River.

droelectric power. The reservoirs were not recommended in 1930, but in 1938 Congress approved construction of Burnsville Reservoir on the main stem of the Little Kanawha, a reservoir on Steer Creek, and a reservoir on West Fork, to aid in controlling Ohio River floods. The West Virginia House of Delegates resolved in 1939 that Burnsville Lake in Braxton County was "essential to the Ohio River flood control projects and will save the property and protect the lives of those living in the Little Kanawha Valley."

None of the three approved reservoirs were begun, however, and during the early 1960's the Huntington Engineers restudied the Little Kanawha basin water problems. As a result, a reservoir on Leading Creek was substituted for the one authorized on Steer Creek, and construction of Burnsville Lake was recommended. The first funds for the Burnsville project were provided in 1965, under the Appalachian development program of the Lyndon Johnson administration, and much of the expected project benefits were allocated to recreation. The benefits it could have for flood control were dramatized, however, by a record Little Kanawha flood in March 1967 that flooded every building, except the poolroom, on main street in Glenville. General Willard Roper of Ohio River Division told a House Committee the Burnsville project could have knocked four feet off the flood crest at Glenville, four and a half feet at Grantsville, and one-foot at Creston, and could have reduced flood damages by half. Editor Linn Hickman of the *Glenville Democrat* said that after the 1967 flood "everyone seemed to agree that the Burnsville Dam should be a must item, for this would cut down the constant flood threat and relieve a large area from worry every year."

Congress appropriated funds to begin construction of the Burnsville project in 1972 and also funded advance planning for Leading Creek Lake in Gilmer County and West Fork Lake in Calhoun and Wirt counties. Burnsville Dam was completed in 1976, but by then the other two

Bluestone Dam and Lake on New River near Hinton, West Virginia—the first in the Great Kanawha River Basin started in 1934 and delayed by World War II, and finished in 1950.

Sutton Dam and Lake on the Elk River at Sutton, West Virginia.

projects had been placed in inactive status.

Massive Program Undertaken in Kanawha Basin

The story was much different in the larger "great" Kanawha River basin, covering parts of West Virginia, Virginia, and North Carolina. Gigantic Bluestone Dam, begun in 1934 as a Public Works Administration (PWA) project, was finished in 1950, and after the Second World War the Huntington Engineers began building Summersville Dam on Gauley River and Sutton Dam on Elk River. Congress had approved five flood control reservoirs for the Kanawha basin in 1938: Summersville on the Gauley, Sutton on the Elk, Poca on the Pocatalico, Birch on Birch River, and Big Bend on the Greenbrier.

Planning for Sutton Dam and Lake, eighty-five miles above Charleston, was begun in 1941, was interrupted by war, and was resumed in 1945. A contract for sealing a coal mine near the damsite was let in October 1949 and in 1950 a contract for relocating a railroad line was awarded, but the project was again interrupted by war—in Korea—in 1950, and not resumed until 1955. Construction of the concrete-gravity dam, forty feet higher than Bluestone, was at last begun in 1956, under the local direction of Major S.R. Fenn, as resident engineer. It was completed in 1961.

At the dedication ceremonies on July 8, 1961, General Walter K. Wilson, Chief of Engineers, lamented the delays in the project, occasioned because the Engineers had to "lay down their picks and shovels" and concentrate on national defense. Sutton Dam had required the placement of a half million cubic yards of concrete—enough for a 170-mile-long highway—and 1.5 million pounds of reinforcing steel—enough for 6,500 automobiles. Eight bridges, fourteen miles of highway, nineteen miles of utility lines, eighteen cemeteries, and more than eight miles of railroad line had been relocated, and a 565-foot tunnel had been punched through a mountain for the new railroad track. "It is a project we can all be proud of," said General Wilson, "a structure of beauty and strength that will endure through the decades and will serve this area and the nation."

Planning for Summersville Dam and Lake on the flood-torn Gauley River was also twice interrupted by war, and construction did not begin until 1960. Under the supervision of Resident Engineer Thomas L. Chapman, J.A. Jones Construction Company drilled the diversion tunnel and built the outlet works, and Western Construction Corporation built the dam. The unpredictable Gauley River, which sometimes surged from a flow of 20 cubic feet per second up to 30,000 cubic feet per second in a matter of hours, caused major problems at the beginning of construction: parts of temporary cofferdams were twice lost to floods and two haul bridges were destroyed. Moving the 12 million cubic yards of materials—enough to build a three-foot-high, three-foot-wide wall from New York to San Francisco and back—required to build the dam might seem an amazing feat, but the Engineers knew how to handle construction problems. It was always the human problems that caused the most difficulty.

Choosing a name for a dam and lake would not seem, on the face of it, very difficult, but there has been a surprising amount of competition among local communities which would like to see a project labeled with the community name. To reduce this human relations problem, the Engineers have long followed the policy of naming projects after the community nearest the damsite. This practice has been foregone, however, at least twice in the Huntington District. The village closest to a dam built in the Muskingum basin in 1934 was a hamlet called Nellie, and Colonel Joseph D. Arthur, Zanesville District Engineer, could not abide the name Nellie Dam. Historians located a long-forgotten Indian village near the damsite, and Colonel Arthur quickly named the project Mohawk Dam. The village of Gad was located near the Summersville project, but Huntington District Engineer Steven Malevich explained to the Chief of Engineers that Gad Dam somehow seemed inappropriate and the name was quietly dropped in favor of Summersville.

One especially interesting feature of the Summersville project was the construction of Summersville Municipal-James D. Ireland Airport as a cooperative venture of the Engineers, the state of West Virginia, and the Federal Aviation Agency to serve nearby communities and visitors to Summersville Lake. The 3,000-foot paved runway was completed on land adjoining the project at a cost of about $350,000, and on March 3, 1967, it saved a six-passenger plane whose pilot was preparing to make a forced landing in the mountains when he saw the airstrip. The airfield was thus credited with saving a $120,000 airplane and perhaps a life from crash damages, while at the same time Summersville Dam was storing 150,000 acre-feet of floodwater to save millions in flood damages.

After six years of construction, Mayor William

Summersville Dam and Lake on the Gauley River provided much needed flood control in this area.

President and Lady Bird Johnson participated in the dedication ceremonies at Summersville Lake.

Summersville Municipal—James D. Ireland Airport showing the lake in the background.

S. Bryant of Summersville, Governor Hulett C. Smith of West Virginia, Senator Jennings Randolph, and President Lyndon B. Johnson dedicated the Summersville project on September 3, 1966. In his address to the Summersville crowd, the President recalled that his friend, historian Walter Prescott Webb, once wrote: "In their efforts to provide a sufficiency of water where there was not one, men have resorted to every expediency from prayer to dynamite. The story of their efforts is, on the whole, one of pathos and tragedy, of a few successes and many failures." The President expressed his personal hope that the power of science and the determination of men, along with prayer and dynamite, would "empower us to quench the thirst of generations to come."

By 1967 the Huntington Engineers had three multipurpose lakes—Bluestone, Sutton, and Summersville—and local protection projects at Galax, Va., and East Rainelle and Princeton, W. Va. in operation in the Kanawha River basin, and were studying Birch Lake on a tributary of Elk River and Moores Ferry Lake on the upper New River near the Virginia-North Carolina line, and local projects such as channel clearance on the Big and Little Coal rivers to remove logging and mining debris. General William L. Starnes of Ohio River Division told a House Committee in 1971 that a "very large and very ambitious project," involving construction of the fourth highest dam in the world on Gauley River near Swiss, W. Va., was considered. But construction of these projects, and all others, would depend on the action of Congress.

Intense public concern about the environmental effects of flood control projects seemed in 1972 to presage the eventual end of construction for flood control and a revolution in water resource development methods.

Then came the "Energy Crisis" of 1973 and the organization of citizens' groups that supported the installation of power generation facilities at Bluestone, Sutton, and Summersville, and the construction of dams primarily for hydroelectric power production. Throughout these developments, the Engineers preserved a remarkable equanimity, secure in the knowledge that the United States and its technological civilization would always have a need for a responsive, capable construction-engineering organization.

Chapter XIV

Flood Control North of The Ohio

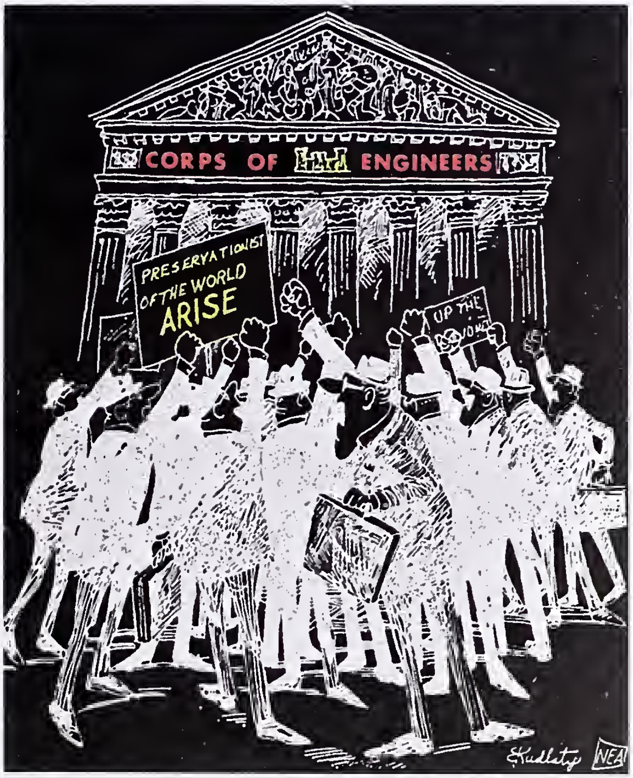
> An elephant is a mouse constructed by the Corps of Engineers!
>
> The Army Corps of Engineers is Public Enemy No. 1.
>
> The Corps, like the beaver, frequently builds dams he doesn't need, but the beaver doesn't do it at taxpayer expense!

These were a few of the more flattering comments made about the Army Engineers during the late 1960's, and the Huntington Engineer District was the target of its full share of such epithets. Population growth, industrial expansion, urban sprawl, pollution, were increasingly recognized as a threat to the aesthetic qualities of life and perhaps a danger to the biosphere itself.

The United States and most of its people had ever been committed to economic expansion, including the construction of dams and improved waterways, and the Engineers had been a vital part of this developmental process, supplying public needs for flood protection, water supply for drinking and sanitation, recreational areas, and waterways for commercial and pleasure craft. The record showed that major progress in these areas was accomplished in the United States and throughout the world in the twentieth century; to illustrate, 2,790 dams were built around the globe between 1900 and 1939—from 1939 to 1962, 5,421 more dams were completed, 2,633 of them in the United States.*

Citizen Groups Seek End to "Development"

The construction of flood control dams and water resource projects was so swift, their effects so revolutionary, that citizens' groups, often labeled "environmentalists," began to call for a halt to water resource development.


CORPS OF ENGINEERS
PRESERVATIONIST OF THE WORLD ARISE
UP THE
NEA

The Corps had its problems with environment protest groups in the late sixties and early seventies.

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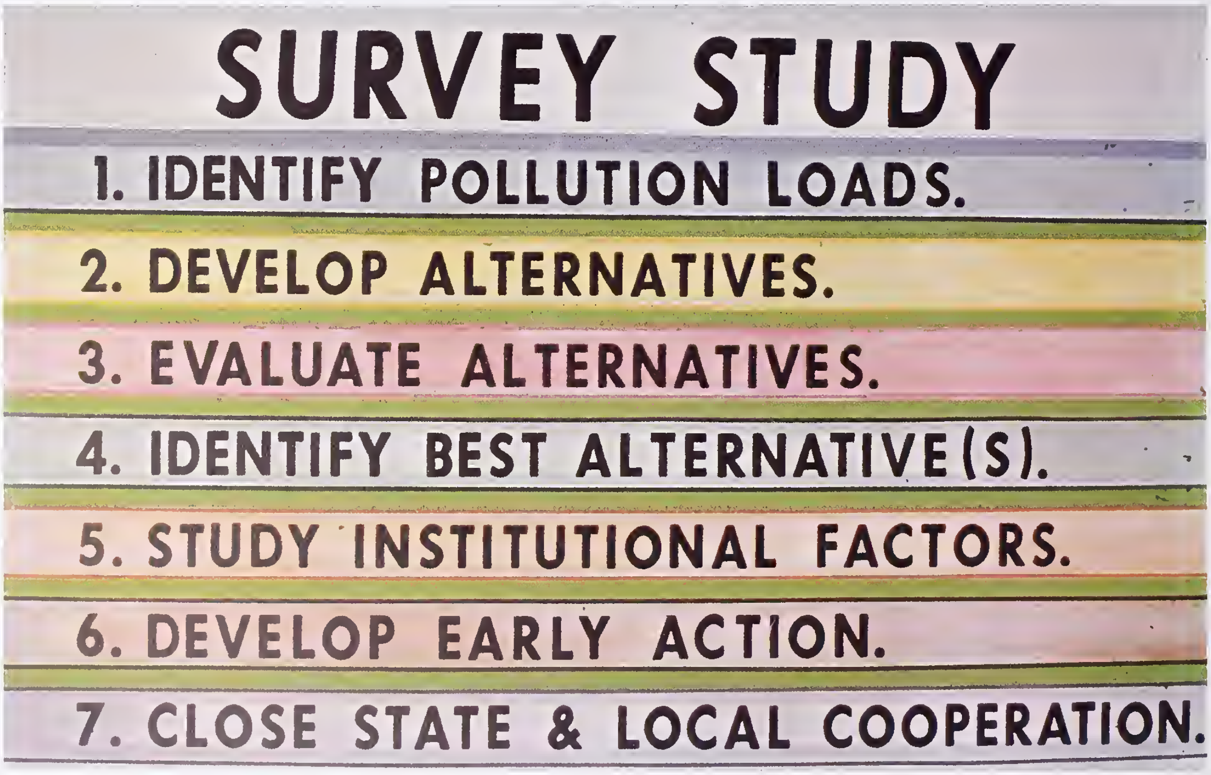
* About ten percent were Corps of Engineers projects.

The environmentalists dramatized to Americans, through publications like Rachel Carson's *Silent Spring*, the grave hazards presented by continued applications of technology, by unbridled development and exploitation of natural resources, by burgeoning population and urban and industrial growth. And public concern about the effects of technology on the environment was having major impact by the late 1960's on American water resource policies. The conservation movement in America, to which the environmentalists traced their origins, first influenced national policies in the administration of President Theodore Roosevelt. Conservationists of the Progressive Era successfully implemented campaigns to preserve National Forests, but water conservation to the early leaders of the movement had mostly meant saving and storing water behind dams for multiple uses—flood control, navigation improvement, water supply, hydroelectric power production, irrigation. The environmentalists of the 1960's, however, came to interpret water conservation to mean not so much the preservation of water as the preservation of rivers and streams in their natural condition.

In short, environmentalists sought to stop the Engineer program for flood control and water resource development, warning that Engineer projects were having adverse impact on bioecology, the natural environment, and that, if the Engineer program continued, there soon would be few free-flowing streams left in the United States. Gripped by the thought that environmentalists might be right, the American public reacted with what seemed near panic, Congress enacted far-reaching legislation to alleviate environmental deterioration, the Environmental Protection Agency (EPA) was established, and in Ohio in March 1972 Governor John J. Gilligan announced he was withdrawing state support from all Corps projects in that state.

At hearings before the Senate Committee on Appropriations in early 1973, General William L. Starnes of the Ohio River Division explained: "The Governor of Ohio and his people feel that a better way to handle the problems of flood control is through the use of management of the flood plain, the flood plain zoning which might prevent people from moving into the flood plain or might move people out of the flood plain who already live there, or perhaps might require a different type of building."

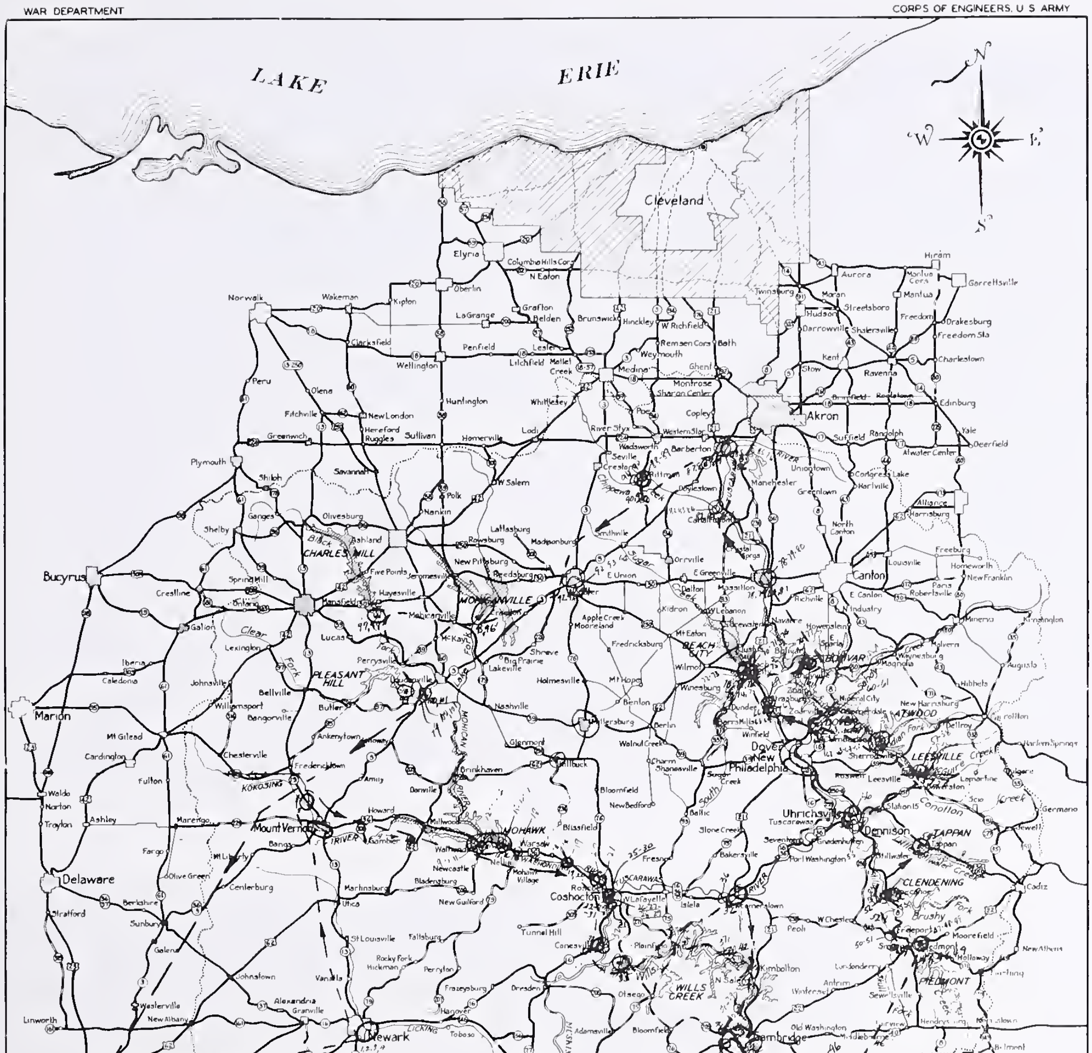
Senator Joseph Montoya asked General Starnes if this step in Ohio were not highly unusual, in view of the fact that other state gov-



SURVEY STUDY

1. IDENTIFY POLLUTION LOADS.
2. DEVELOP ALTERNATIVES.
3. EVALUATE ALTERNATIVES.
4. IDENTIFY BEST ALTERNATIVE(S).
5. STUDY INSTITUTIONAL FACTORS.
6. DEVELOP EARLY ACTION.
7. CLOSE STATE & LOCAL COOPERATION.

Water Resource Management studies were introduced in this era to alleviate some adverse public opinion.


WAR DEPARTMENT
CORPS OF ENGINEERS, U S ARMY
LAKE ERIE
N
S
E
W
Cleveland
Akron
Canton
Elyria
Norwalk
Bucyrus
Marion
Delaware
Mansfield
Wooster
Mount Vernon
Coshocton
Dover
New Philadelphia
Uhrichsville
Dennison
Newark
Zanesville
Cambridge
COLUMBUS
Lancaster
Marietta
Athens
CHARLES MILL
MOHICANVILLE
PLEASANT HILL
MOHAWK
BEACH CITY
BOLIVAR
DOVER
ATWOOD
LEESVILLE
TAPPAN
CLENDENING
PIEDMONT
WILLS CREEK
SENECAVILLE
~LEGEND~
Hard surfaced roads
Principally stone or gravel
Good county roads
Earth or badly worn surface
7 State route number
United States highway number
Boundary of Zanesville District
Dam and Reservoir
ZANESVILLE ENGINEER DISTRICT
HIGHWAY MAP
U S ENGINEER OFFICE ZANESVILLE, OHIO

Highway map of Zanesville District after completion of the original fourteen dams in 1938.

Pleasant Hill Lake

Wills Creek Dam

Two of the original Zanesville District projects.

Dillon Dam and Lake on the Licking River was completed in 1961.

ernments were fighting for more federal funds for flood control, and what the Corps' position on the matter might be. General Starnes replied: "If the Governor doesn't want anything built in his state, I think almost without exception the Corps of Engineers has never built anything the Governor didn't want, and so that's our policy."

Ohio did have an abundance of flood control projects. Louisville Engineer District was building in the Miami and Little Miami River valleys; Pittsburgh Engineer District was building in the Beaver River basin; the North Central Division had projects in the Lake Erie watershed; and the Huntington District was responsible for most of southeastern Ohio—the Muskingum, Hocking, and Scioto basins, and the basins of various direct tributaries of the Ohio. The Engineers had been at work on the section of the Huntington District north of the Ohio River since 1934 and had made important progress toward flood control. Sixteen flood control and multipurpose dams, including the fourteen built by Zanesville District from 1934 to 1938, had been completed in the Muskingum basin, two had been built in the Scioto basin, and one in the Hocking basin, and in 1976 several other reservoir projects were under construction and in preconstruction phases.

Further Flood Projects in Muskingum Basin

As the Zanesville District completed the fourteen Muskingum Watershed Conservancy District (MWCD) dams in 1938, Congress had approved three more flood control reservoirs in the Muskingum Basin—Dillon Reservoir on Licking River, Frazeysburg on Wakatomika Creek, and Millersburg on Killbuck Creek. The Dillon project, five miles above Zanesville on the Licking, was selected for early construction in 1939, but work was delayed by World War II. The Dillon project lay partly in the district of Congressman Percy W. Griffiths of Marietta and partly in the district of Congressman J. Harry McGregor of West Lafayette, and the quarrel between these two Representatives that emerged at hearings on the Dillon project in 1946-47 was a classic example of the "upstream versus downstream syndrome."

Congressman McGregor, representing an upstream constituency, declared he was opposed to the Dillon project because thousands of farmers and residents would be uprooted and removed to make room for the reservoir. Congressman Griffiths supported Dillon because the people of his district, from Zanesville to Marietta, "had to get in there an average of almost once a year to clean out mud." Governor Frank J. Lausche and Ohio Senators John W. Bricker and George W. Bender threw their support behind the project, and Congress appropriated funds for its construction.

The building of Dillon Reservoir had a spotty history. The Huntington Engineers let a contract for relocating railroad lines in the Dillon Reservoir area in June 1946, but terminated the work when funds were exhausted in 1947. Work was resumed in 1950, but the building of the dam had not been started before the exigencies of the Korean police action again forced suspension. When work was started again in 1956, under the local direction of Resident Engineer Ed Snyder, the Engineers and the contractors moved with all speed, completing the 118-foot-high, 1,350-foot-long earthfill dam in 1961.

While Dillon was still being built, the Muskingum basin suffered a severe flood in January 1959 that on some tributary streams exceeded all previous records. The dams of the MWCD project worked effectively, cutting over eleven feet off the flood at Zanesville, but damages were high at towns like Fredericktown, Canton, and Newark, located upstream of the protection supplied by those dams. Mount Vernon, Ohio, was badly damaged when a locally built levee along Kokosing River failed and the stream rushed into the city. In the aftermath of the 1959 flood, intense public support for flood protection projects developed, and the Ohio Department of Natural Resources urged construction of several local flood protection projects, plus multipurpose reservoirs for flood control on North Branch Kokosing River and at the Utica site on North Fork of Licking River.

The Huntington Engineers had a stream channel improvement project under way at Roseville in Muskingum and Perry counties at the time of the 1959 flood which was finished in 1960. Congress authorized a similar channel rectification project at flood-devastated Mount Vernon on Kokosing River in 1962, and the Engineeers finished this project three years later. Congress also authorized in 1962 a small flood control reservoir on North Branch Kokosing River for the protection of Fredericktown, Mount Vernon, and downstream communities. Resident Engineer Kenneth Zimmerman directed rapid construction of the rolled earthfill North Branch Kokosing River Dam. It was begun in 1970 and completed in 1971, a year ahead of schedule, thanks to favorable weather and hard work by the contractor.

Stream Channel Improvement Project at Roseville, Ohio, completed in 1960.

North Branch of Kokosing River Lake, a small lake for the protection of Fredericktown and Mount Vernon, Ohio, completed in 1971.

The Huntington Engineers also began studies of the Utica Lake project above Newark on North Branch of Licking River after the 1959 flood, adding provisions for water supply features at the request of the city of Newark, whose water supply had failed during the drought of the summer of 1964. Huntington District Engineer William D. Falck reported in 1966 that Utica Lake could reduce flood damages along the North Fork of Licking River, could meet area water supply needs until about 2020, and would probably be visited by about 450,000 recreationalists annually. Colonel Falck recommended that the Utica Lake project be built, provided Newark or the state of Ohio paid the costs allocable to water supply and recreational development, and the project was authorized by Congress in 1968. The opposition to the Utica project expressed by Governor Gilligan in 1973 put the project in jeopardy, however, and in 1976 it was doubtful whether it would be constructed.

While the Utica Lake controversy was in progress, the Muskingum Watershed Conservancy District continued its fine work year by year around the Muskingum basin lakes. The editor of the conservative *Cleveland Plain Dealer* wrote in 1956: "There is no gainsaying the fact that the 14 dams previously built, dating back to 1938 originally, have converted a not-too-fruitful part of Ohio into a section offering fine vacation and recreation opportunities. And the flood control aspects have worked admirably." In early 1974, Colonel Kenneth McIntyre of Huntington District presented Donald Agnew, president of the MWCD board of directors, with an award—the highest civilian award given by the Army Engineers—recognizing the services of the MWCD in developing recreation areas enjoyed by millions and stimulating area economic growth. The Zanesville District had built well: the Muskingum dams had prevented $286 million in flood damages from their completion in 1938 to 1975.

Flood Protection in the Scioto Basin

A series of conservancy districts in the Scioto River basin, west of the Muskingum, had sought to develop a program similar to those of the Miami Conservancy District and the Muskingum Watershed Conservancy District (MWCD), but without similar success.

The Franklin County Conservancy District, organized at Columbus soon after the 1913 flood, studied various flood protection projects, one of which was a flood control dam and reservoir on the Olentangy River near Delaware, but never found sufficient support to undertake any of them.

Counties in the upper Scioto and Sandusky River basins joined in the Scioto-Sandusky Conservancy District in 1934, hoping to obtain assistance through the Public Works Administration for projects like those of the MWCD. In the Depression years, the economic relief and employment aspects of flood control were important. Congressman William A. Ashbrook said, in a letter to the Chief of Engineers in 1935:

> This project is a matter of importance to Delaware county, which is in my Congressional district. Delaware County has no manufacturing concerns and if they could get two dams, it would certainly help that fine county. The bank and building and loan failures have just about ruined the county. I do not know of any county in Ohio that needs help more than Delaware County. I am informed that the Scioto-Sandusky project would give employment to six or eight thousand men for three or four years.

Dr. C.E. Sherman, professor of engineering at Ohio State University, was chief engineer of the Scioto-Sandusky Conservancy District, and he and his staff planned a broad program of water, soil, and forest conservation in conjunction with flood control dams on the main stem of the Scioto near Bellepoint, on the Olentangy River near Worthington and Delaware, on Scioto tributaries such as Rocky Fork, Salt Creek, and Paint Creek, and in the upper Sandusky River basin. An unusual feature of Professor Sherman's plans involved excavation of a diversion cut to connect the Scioto and Sandusky valleys to divert floodwaters from one basin to the other to be stored for release during droughts.

The Scioto-Sandusky Conservancy District never received PWA funding, because, it was said, the Governor in 1934 demanded that the funds be appropriated directly to the Conservancy District, rather than to the Army Engineers as was the case on the Muskingum. In 1938, Professor Sherman asked Senator Robert Bulkley to act quickly should PWA funds become available and urged the Senator to pressure the Chief of Engineers for swift completion of an Engineer survey of the Scioto. The Professor was convinced the proposed Delaware Reservoir on the Olentangy could effect more reductions in Ohio River floods than any other in the Ohio basin and felt sure the Army Engineers would so report. And so the Engineers did report in 1938, proposing five reservoirs in the Scioto basin—Delaware, Rocky Fork, Big Darby, Deer Creek,

Delaware Dam and Lake on the Olentangy River was the first to be constructed in the Scioto River Basin.

Deer Creek Dam and Lake, completed in 1968. The recreational facilities, complete with campground here and at other lakes in the Scioto Basin are leased to the Ohio Department of Natural Resources.

and Paint Creek—with the Delaware project recommended for immediate construction to protect the Delaware and Columbus urban areas and to relieve some of the water supply problems of the region. "Combined projects of this nature," said Colonel Roger G. Powell of ORD, Ohio River Division, "could considerably reduce the cost of the development chargeable to flood control"

Congress authorized the five Scioto basin reservoirs in 1938, and after World War II was concluded the Cincinnati Engineer District in 1946 began building the Delaware project, six miles north of Delaware, on the Olentangy. The Huntington District assumed charge of the project in 1947. After two years of construction, the three-mile long L-shaped earthfill dam, with a concrete, gate-controlled spillway, was completed at a cost of $7.6 million. After just ten years of operation it had returned benefits in excess of $12 million. The Ohio Department of Natural Resources developed recreation facilities around the ten-mile long conservation pool that attracted droves of visitors. On a single Sunday afternoon in June 1969 about 27,000 people were counted at Delaware Lake enjoying fishing, boating, picnicking, and swimming.

For a decade after the completion of Delaware Dam the Engineers were tied up by Korean and Cold War military construction and by high-priority flood control work in other basins, and little public support for more flood control in the Scioto basin was evident. The state of Ohio built the Rocky Fork Lake project in 1953 on a tributary of Paint Creek west of Chillicothe for conservation and recreation purposes, not flood control; and the city of Columbus completed Hoover Reservoir on Big Walnut Creek for water supply in 1954, supplementing Julian Griggs Reservoir, built in 1905, and O'Shaughnessy Reservoir, finished in 1924.

A flood in January 1959, which exceeded records set in 1913 on some Scioto tributaries, reawakened area civic and political leaders to the need for flood protection in the Scioto basin.

Torrential rains on saturated ground in January 1959 generated roaring floods throughout Ohio, taking sixteen lives, causing damages of over $100 million, flooding 17,000 buildings, and forcing evacuation of some 50,000 people from the flood zones. Delaware Dam effected significant reductions on the Olentangy, but other streams ran rampant. Water overtopped the Dry Run levee at Columbus and flooded areas in the western section of the city, while Alum and Big Walnut creeks flooded areas in the eastern section. Water and sanitation plants at Circleville, Kenton, Marion, and Chillicothe were water covered. In describing the flood, officials of the U.S.

Geological Survey wrote: "Thus the value of flood control and the need for additional control in the Scioto River basin were underlined by this disaster. About $6 million damage was prevented by Delaware Reservoir alone."

A new Scioto Conservancy District was organized after the 1959 flood, and the Huntington Engineers pursued the Scioto basin survey report to completion, identifying specific needs for flood control, water supply, recreation, and pollution abatement. In 1962 the Huntington District suggested rapid construction of the Big Darby, Deer Creek, and Paint Creek reservoirs, which had been authorized in 1938, authorization and construction of reservoirs on Alum Creek, Mill Creek, and Salt Creek, plus channel improvements and levee projects at Columbus and Chillicothe. Congress approved these plans in 1962.

Resident Engineers Thomas L. Chapman and Thorne C. Craig directed construction of Deer Creek Lake from 1965 to 1968. Completion of the rolled earthfill dam, with concrete-gravity channel section and gate-controlled spillway, was delayed somewhat by labor strikes, but the dam was far enough along to hold 18.5 billion gallons of water rushing down Deer Creek during a flood in May 1968.

Deer Creek Dam, nestled in the gently rolling hills of Pickaway County, seventeen miles west of Circleville, received the Army Chief of Engineers Design Award. It was dedicated on September 21, 1968, by Colonel Maurice Roush of Huntington District, Governor James A. Rhodes of Ohio, and Congressman William H. Harsha. A feature of the Deer Creek project of historical interest was the cabin, or the "Shack," once owned by Harry Daugherty, Attorney General of the United States and close confidant of President Warren G. Harding of Marion, Ohio. The cabin, supposedly the scene of much political campaign planning during the Harding era, was first scheduled for demolition and removal, but Resident Engineer Chapman suggested it might be worth saving. The state agreed, and planned to use the cabin as part of a lakeside recreational complex.

Paint Creek Lake in Highland and Ross counties on a tributary of the Scioto west of Chillicothe was placed under construction in 1967. The construction was typical of most other rolled earthfill dams built by the Huntington Engineers in Ohio, but a new technique was adopted in drilling the outlet tunnel. It will be recalled that in 1917 Assistant Engineer Thomas E. Jeffries at the Charleston Suboffice had suggested the En-

Paint Creek Dam and Lake, completed in July 1973.

Alum Creek Lake for flood control, recreation, and water supply, located above Columbus, Ohio.

gineers might use electrified light rays to bring down German Zeppelins bombing London. In 1967, after a half century of work by inventors and engineers, the "laser beam" had been perfected, and it was used for peaceable purposes at Paint Creek. As explained by Resident Engineer Vincel L. Odale, representing the Huntington Engineers at the Paint Creek project, the contractor for the outlet tunnel mounted laser equipment outside the tunnel to project a three-inch red spot of light along the center line of the tunnel, permitting drilling at a more rapid pace without concern that tunnel alignment might not be accurate.

Paint Creek Dam was completed in July 1973 and the project was dedicated June 15, 1974. The Ohio Department of Natural Resources assumed the responsibility for maintenance and operation of recreational facilities at the project.

Land acquisition for the Big Darby Lake project, the last of the Scioto basin reservoirs authorized by Congress in 1938, was begun in 1971. Uncertainty developed concerning this project, however, and in 1976 it was under review as a part of the Central Ohio Survey. It was expected that Big Darby, to be located on Big Darby Creek in Franklin and Madison counties about seventeen miles southwest of Columbus, would, if built, be heavily used for recreation by people of the Columbus area.

Thus, four of the five flood control reservoirs authorized by Congress in 1938 for the Scioto River basin were in operation in 1976, though one of them was built by the state without flood control as an objective.

The reservoirs authorized after the 1959 flood disaster—on Alum Creek, Salt Creek, and Mill Creek—encountered a variety of problems.

Alum Creek, flowing from the northeast to Big Walnut Creek and the Scioto at Columbus, reached stages as much as six feet above 1913 records in January 1959, causing about $3 million in flood damages. The Alum Creek project was planned for flood control, recreation, and water supply. Columbus and other nearby communities could draw fifteen million gallons of water per day from Alum Creek Lake for water supply, a direct project benefit that would be paid for by Ohio. But in Delaware County, whose Congressman had pleaded in 1934 for federally funded flood control reservoirs, intense opposition to the Alum Creek project developed in 1969. Clyde Lewis, representing the Delaware County Commissioners, told a Senate Committee:

> We now have a problem which is assaulting us. It is going to lead, we are afraid, to near bankruptcy on behalf of our small county of some 36,000 people. We are described as the most dammed county in the United States. We have five dams in our county, two of them now in the

> process of construction, Alum Creek and Mill Creek, and our problem is that we are going to be not only inundated by water, but by the interested hordes of people who seek to dip their canoes or other parts of their anatomy into our water, and it is projected that we will have as many people in our small county as are contained in the cities of Chicago and Cleveland together.

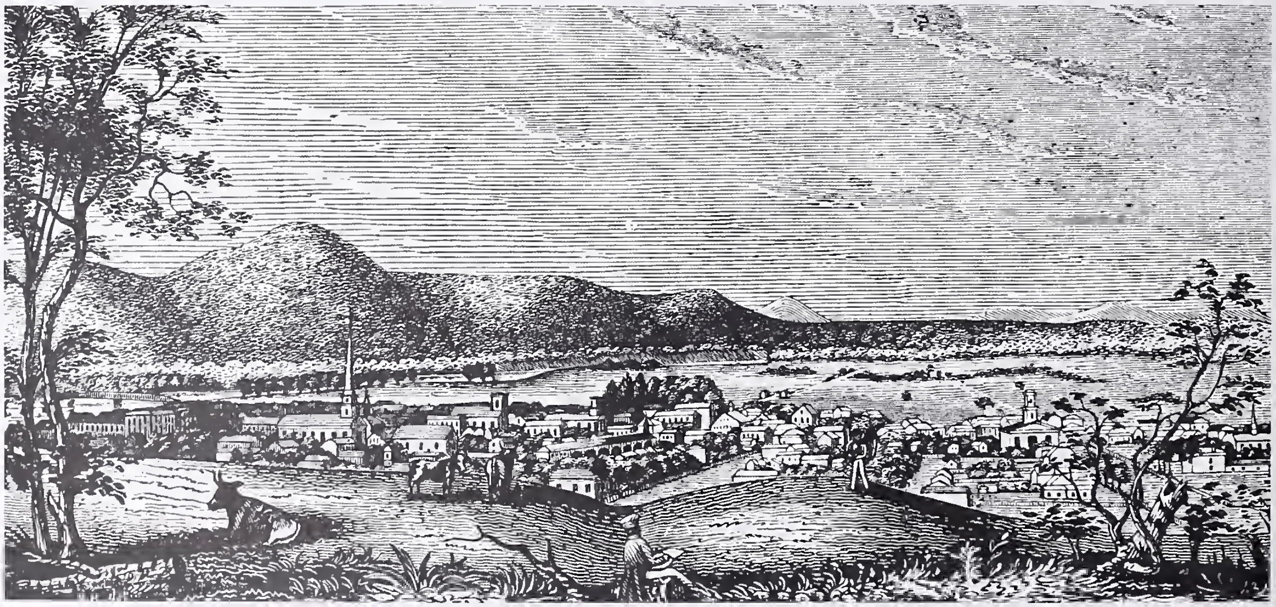
Mr. Lewis said Delaware County was losing its tax base because of the reservoirs and suffered heavy law enforcement and road repair costs as a result of the tourist influx. The Senate Committee agreed that Delaware County had a "knotty" problem and directed the Huntington District to rework project plans for Alum Creek, eliminating some land acquisition for recreation. Delaware County had won a victory of sorts.

Under the direction of Resident Engineer Joseph R. Turner, construction of Alum Creek Dam, another rolled earthfill structure with a concrete spillway, was begun in 1970 and completed in 1974. One unique engineering-construction innovation was the use of a coal saw to cut rock around the perimeter of excavations. By this means the walls were left smooth and straight, and concrete placement was simplified.

Coal saws, concrete saws, laser beams, and all types of new equipment and construction methods, each a minor innovation, but in aggregate a revolution, were effecting major changes and economies in the construction industry and in the way Engineer projects were built. Construction in Addison Scott's day did not vary materially from construction in ancient times—picks, shovels, hand drills, sledgehammers, cut-stone masonry were still standard. But less than a century later, at projects such as Alum Creek, none of these tools were much used.

The Huntington Engineers were planning construction of Salt Creek Dam, Mill Creek Dam, and the Chillicothe local flood protection project, the last elements of the comprehensive plans for the Scioto basin adopted by Congress in 1962, when, in 1972, Governor Gilligan withdrew state support. As it worked out, the Chillicothe project, a levee and concrete floodwall to protect a major section of Chillicothe from Scioto River floods, was later allowed to proceed, and construction was begun in 1975. The project included some unusual plans for recreation, with a bike trail along the levee crest, picnic facilities, a playground and "tot lot," and platforms for fishing. Thus would be created a relaxing setting in the middle of Chillicothe, to be known as Scioto Park.

Ohio had strongly supported the Salt Creek and Mill Creek projects originally. In 1965, for example, the state Department of Natural Resources presented a resolution to the House Public Works Committee urging immediate construction of the Mill Creek project, because, the resolution read, flood control and low-flow augmentation had "become urgent with the region's great population growth." Congressman Joe L. Evins commented in 1971 that Ohio had been lucky in the case of the Salt Creek and Mill Creek projects, because they were approved by Con-



—Howe's Historical Collections of Ohio, Vol. III

Chillicothe, Ohio, located in the Scioto River Basin, 1846.

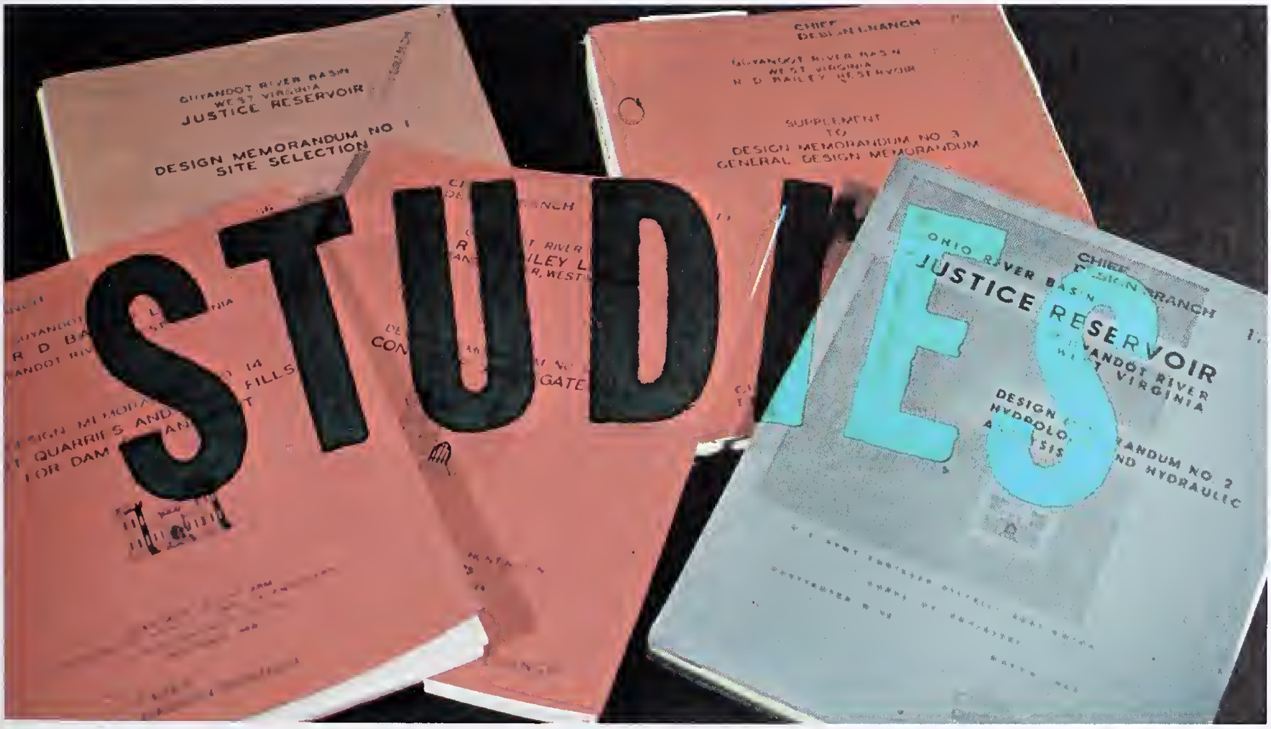
gress in 1962. "It is a great State," he said, "but the committee notes that Ohio is fortunate the project was authorized before the requirement of cost sharing on the construction of recreation facilities." The future of the Salt Creek and Milll Creek projects was thrown into doubt, however, when Governor Gilligan removed his support, suggesting that floodplain management might be a better method of approaching flood problems than the construction of more dams and reservoirs.

Impetus Given to Floodplain Management

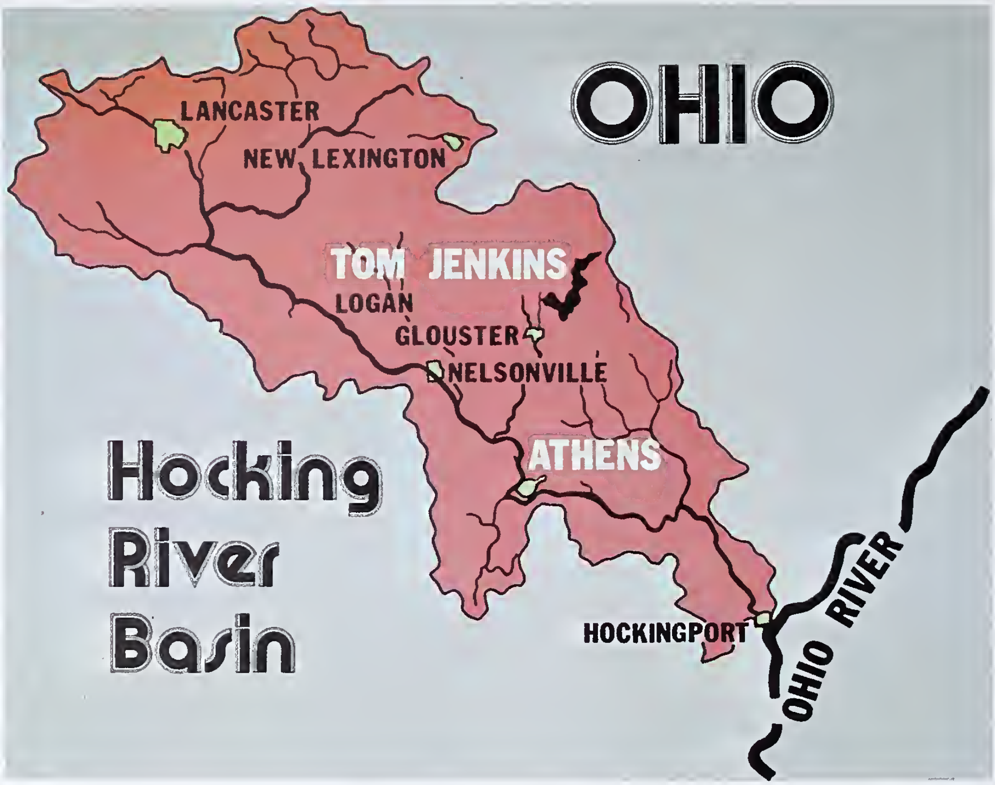
The Corps of Engineers had begun a floodplain management program in 1961 after Congress and the Corps had noted that, despite the construction of flood protection projects, average annual flood losses were increasing instead of decreasing, even when adjusted to changes in the value of the dollar. Annual flood damages rose from about a half billion dollars nationally in 1936 to over a billion a year by 1966, chiefly because burgeoning population created imperative demands for land for homes, business centers, and industrial plantsites, and caused urban sprawl into the countryside surrounding cities, frequently into the attractive level lands in river valleys.

The idea of evacuating floodplains, or limiting development in river valleys was old. The Ohio River Flood Board, for example, suggested flood plain zoning as a solution to flood problems during its studies of the 1913 "Dayton Flood." But little was done to institute floodplain management, also described as "nonstructural flood control," until after 1950, when some engineers began to advocate the testing of such flood control measures. The most vocal proponent of floodplain management in the 1950's was probably General Herbert D. Vogel, an Engineer officer who also served as director of the Tennessee Valley Authority. (General Vogel was the brother of Karl Vogel, the airfield expert and former chief of construction of the Huntingtion District). General Vogel wrote in 1960: "Time works against us. No matter how energetically we build, we fall further behind in the task." The answer lay, General Vogel maintained, in the recognition by states and municipal governments of their responsibilities in adopting preventive as well as corrective measures, because "flood damage *avoidance* goes hand in hand with flood *control*."

Floodplain management branches were established in Engineer Districts across the nation in 1961, with the task of preparing floodplain information studies at the request of local governments, and furnishing local agencies with the data necessary to enact zoning ordinances de-



Flood Plain Management information distributed to the public.



The Hocking Basin, though smaller than the Scioto and Muskingum Basins, has a flood history similar to them.

signed to prevent building on sites where flood damages were likely. The problem was that after such reports were completed local governments often failed to act upon them, for zoning restrictions have historically been a touchy local political problem.

President Lyndon B. Johnson proposed in 1966 to put some "teeth" in the floodplain management program by developing a large-scale federal flood insurance program, by mapping "flood risk zones" throughout the nation, and by beginning a joint federal-state-local effort to prevent further structural development in high flood-risk zones. Part of this "get-tough" program was enacted by Congress in late 1973. Known as the Flood Disaster Protection Act, the 1973 law required flood-prone communities to enter into the Flood Insurance Program by July 1, 1975. The act made available flood insurance partially subsidized by the federal government, provided the communities participating in the program had enacted land-use zoning laws to prevent construction in low-lying areas. Communities not participating would no longer be eligible for mortgages and loans from the Small Business Administration, the Veterans Administration, the Federal Housing Administration, or other federally backed lending institutions. The extent to which the law would achieve the desired results remained to be seen.

Hocking Basin Flood Protective Measures

Wedged between the larger Scioto and Muskingum basins, the Hocking River basin has had a flood history somewhat similar to that of the two larger basins. The Hocking valley suffered severe flood damages in 1873, 1884, 1907, and 1913. The flood of March 13, 1907, killed seven people, was the most destructive, and set the record for most river reaches.

In the 1931 "308 Report" on the Hocking, Huntington District Engineer Fred W. Herman reported that local interests had built a channel rectification project on the Hocking River at Lancaster and on Rush Creek, the largest Hocking River tributary, but that these projects had protected adjacent lands at the expense of increased flood damages in areas below the rectification works. Major Herman said there was a fine reservoir site, known as the Frost site, on the Hocking about 10.4 miles above its mouth, which could reduce Ohio and Mississippi river floods, but as a project at that location would provide little protection for the Hocking Valley itself, it was not recommended.

After the historic 1937 flood, the Huntington Engineers restudied possible flood control reservoir sites in the Hocking basin and recommended a project on Clear Creek near Logan, Ohio. This was authorized by Congress in 1938; and in 1941, after further studies, the Engineers also recommended a flood control and water supply reservoir at the Burr Oak site on East Branch of Sunday Creek and a local protection project at Athens, on the main stem. Local interests and the state of Ohio said they were willing to participate in the Burr Oak project on Sunday Creek by contributing funds toward its water supply features, and Chief of Engineers Eugene Reybold recommended that Burr Oak be constructed as soon as the emergency military construction of World War II had ended.

Upstream interests in the Burr Oak Lake area presented strong opposition to the project. One landowner wrote:

> This is one of the most outrageous projects ever put on any people. The farmers are up in arms against such doing. Most of the farmers like myself, are growing old, put their best days in trying to get a home in their old days. Now to be ruthlessly rooted out, for a project so uncalled for as this, is outrageous. Politics and greed is at the bottom.

The water supply feature of the Burr Oak project was attractive to the nearby communities plagued by continual water shortage. Proponents of the project, led by Congressman Tom Jenkins of Ohio and the Burr Oak Association, plodded through a maze of seemingly endless hearings, nursing Burr Oak through committee and Congress until they gained congressional approval in 1944. Bulldozers began gouging out the earth and pushing it to the Burr Oak damsite on March 1948, completing the 84-foot-high earth- and rockfill dam 3.5 miles north of Glouster, Ohio, in February 1950. Pipelines from the lake poured the water that had formerly flooded the valley into nearby Glouster, Jacksonville, Trimble, Hollister, Murray City, Carbon Hill, Shawnee, and New Straitsville for domestic use, and no further major flooding, other than a flood of recreationalists, was experienced in picturesque Sunday Creek valley. Congress changed the name of the dam in 1952 to honor its most ardent advocate, Congressman Tom Jenkins, but the name of the lake remained Burr Oak.

For fourteen years after the completion of Burr Oak Lake, nothing more was done for flood control in the Hocking valley. Then, in March 1964, the city of Athens and Ohio University found

Burr Oak Lake and Tom Jenkins Dam on East Branch of Sunday Creek, the only flood control lakes in the Hocking Valley.

themselves immersed in water nearly as deep as that of 1907. The situation was so critical that President Lyndon B. Johnson and Governor James A. Rhodes, accompanied by the Chief of Engineers and General Walter P. Leber of the Ohio River Division, flew over the flooded valley in Air Force One to inspect the damage. Public support for more flood control work grew dramatically, especially at water-soaked Athens.

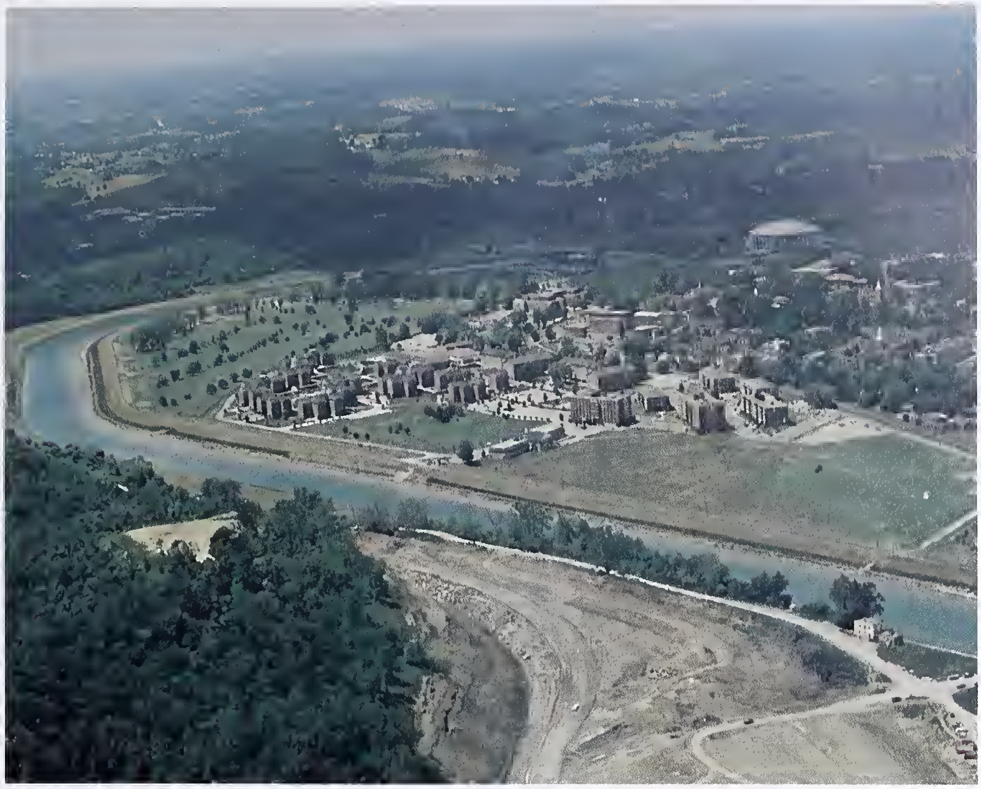
President Vernon R. Alden of Ohio University at Athens urged "expeditious" construction of channel improvements and levees to protect Athens and the university and also to provide more room for municipal and university growth. Ohio University Vice President Martin L. Hecht explained to a Senate Committee: "Ohio University has given great emphasis and support to this project. Since the University's inception as provided in the Ordinance of 1787 and since its chartering in 1804 by the State of Ohio, the University in expansion and development has been plagued by floods."

Colonel Harrington W. Cochran of the Huntington District recommended construction of the Athens local protection project in 1965, the Hocking Conservancy District furnished assurances of local cooperation, and the Conservancy District even advanced construction monies until Congress supplied federal funds. Ground was broken at Athens in April 1969 and Resident Engineers Joseph R. Turner and Anthony Tomlinson directed the work of the Ralph Myers Contracting Corporation in moving the Hocking River. Five miles of new channel was sliced out of the floodplain, new bridges were built, utilities were relocated, and a hundred other tasks were performed.

Environmental Damage Becomes Public Concern

The Athens project was built at the peak of public concern over environmental deterioration, a concern that received its most articulate expression on college and university campuses. The problems that arose at the Athens project, where the Huntington Engineers, representatives of the so-called "Public Enemy No. 1," were rechanneling a river right through a university campus can be imagined. Had not university officials been unswaying advocates of the project, the situation might have been very unpleasant. William E. Sinozich and Paul D. Adams of the Huntington District traveled to the "lions' den"

Athens, Ohio, showing the Athens State Hospital in the background, during one of the worst floods in the Hocking Valley in July 1873.



Athens, Ohio, today, with an entire new look. Five miles of the Hocking River was relocated to make the area safe from future floods.

on Earth Day in 1970 to speak to the University Ecology Group. They found the group amenable to reason, however, and sincerely concerned about the ecological effects of the Athens project.

On the other hand, at a similar program at Denison University at Granville, Ohio, D. Eugene Lawhun and Paul D. Adams were heckled by militant students during a discussion of the proposed Logan Lake on Clear Creek of the Hocking, probably the most controversial project in Huntington District history. The Athens project was completed and dedicated in May 1972 and received the Distinguished Design Award, but concern for environmental effects stymied the Logan Lake project.

"Sometimes a fellow gets unpatriotic and begins to feel that this is not a government of the people, by the people, and for the people, but rather a U.S. Army Corps of Engineers tyranny," wrote Karl H. Maslowski in the *Cincinnati Enquirer*. The Army Engineers were out to destroy Clear Creek Gorge, Maslowski asserted, along with many rare plants, eighteen kinds of nesting wood warblers, and the unusual wood rat. This was kinder than some other remarks made about the Logan Lake project.

The controversy began at a public meeting at Logan, in 1964, where Colonel Cochran presented the Engineer plans for the project and several environmentalist organizations expressed their opposition. John W. Wolfe of the Environmental Services Branch of the Atomic Energy Commission said news of the possible destruction of the "Museum of Environment" that was Clear Creek was sad, and declared:

> Modern engineering projects everywhere need to be geared to a basic understanding and appreciation for the total ecology—physical and biotic—in space and projected into time. To ignore, or play in low key, the biological relations of such endeavors on this planet or others, is to be somewhat short in circumspection. For ignorance of man's bioenvironment at an ecological level, especially in a technologically enlightened age, can result only in extended disaster, culminating in a tragic end to his dominion over the earth.

Such cogent explanations of the environmentalists' point of view were, however, rather rare in the emotional confrontations between proponents and opponents of the Logan Lake project.

Colonel Maurice Roush presided over a six-hour public meeting at Logan in 1969 that was particularly acrimonious. Mayor M.B. Haney of Logan proclaimed his support for the project because the thousands of "honest taxpaying citizens" deserved relief from annual flooding.

Harry Schulte, a student from Westerville, Ohio, asked: "Is recreation flooding a gorge so you can have a thousand people there on a hot afternoon? This is not my idea of recreation." Lester Farmer of Lancaster, Ohio, recalled his experiences during a Clear Creek flood: "I'm telling you that it was really a mess, getting out- . . . . . How would you people on a highland like that? I suppose some of you were up in this gorge talking about it, maybe at the same time having a good time looking around while these poor people down in this Valley were just suffering." Biologist David D. Blyth said he favored flood control, but wanted Clear Creek Gorge preserved, predicting that many benefits would come from research in the gorge. And so it went, for hours. The upshot of the controversy was the tabling of the Logan Lake project for restudy and detailed consideration of its environmental effects.

Corps Commitment to Environmental Assessment

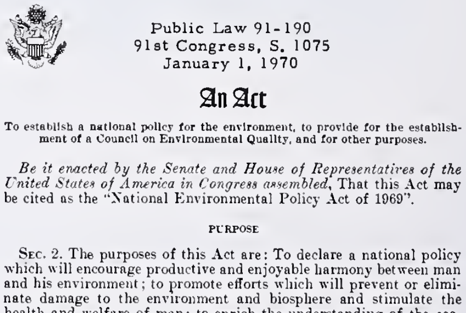
Public enthusiasm and student militancy about environmental issues had waned by 1976, but Congress had written many of the primary objectives of environmentalists into law by then and the Corps of Engineers appeared committed to full assessment of environmental effects, along with economic and engineering considerations, at each project.

President Richard M. Nixon signed the National Environmental Policy Act (NEPA) on January 1, 1970, which declared it to be national policy to encourage productive harmony between man and his environment. In this act, Congress recognized the profound impact population growth, dense urbanization, industrial expansion, resource exploitation, and technology were having on the American environment and made it national policy to "use all practicable means and measures . . . to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony." The President commented as he signed the NEPA that the 1970's would be the decade when America "pays its debt to the past by reclaiming the purity of its air, its waters and our living environment. It is literally now or never."

Section 102 of NEPA required the preparation of environmental impact reports on each federal project that might disturb the environment in any way. It was not clear that NEPA required preparation of impact statements on projects under way at the time NEPA was enacted, but Chief of Engineers Frederick J. Clarke ordered the Engineers to prepare statements on all projects to comply with both the letter and the spirit of NEPA; and the General led a sweeping campaign to commit the Corps totally to the goals of NEPA. He explained in 1971:

> Our efforts in the Civil Works Program are changing . . . to reflect the public's growing desire that the development of our natural resources for economic benefits no longer be the sole criteria for our work. Rather, people seem willing to forego, or to pay more for, their immediate needs so that the quality of their environment may be preserved and enhanced for the future.

The Chief of Engineers met regularly with representatives of environmentalist organizations to hear their views and to incorporate their ideas into the Engineer program. Engineer Districts and Divisions throughout the United States employed environmental staffs. At Huntington District, for example, Dr. A.E. McCaskey, former Dean of the College of Applied Science at Marshall University, joined the District in 1971 as Special Assistant for Water Quality. He commented his work with the Engineer would permit active participation "in the expanding role of the Corps of Engineers in cleaning up our environment."



Public Law 91-190
91st Congress, S. 1075
January 1, 1970

An Act

To establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969".

PURPOSE

Sec. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

Sec. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;
(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;
(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

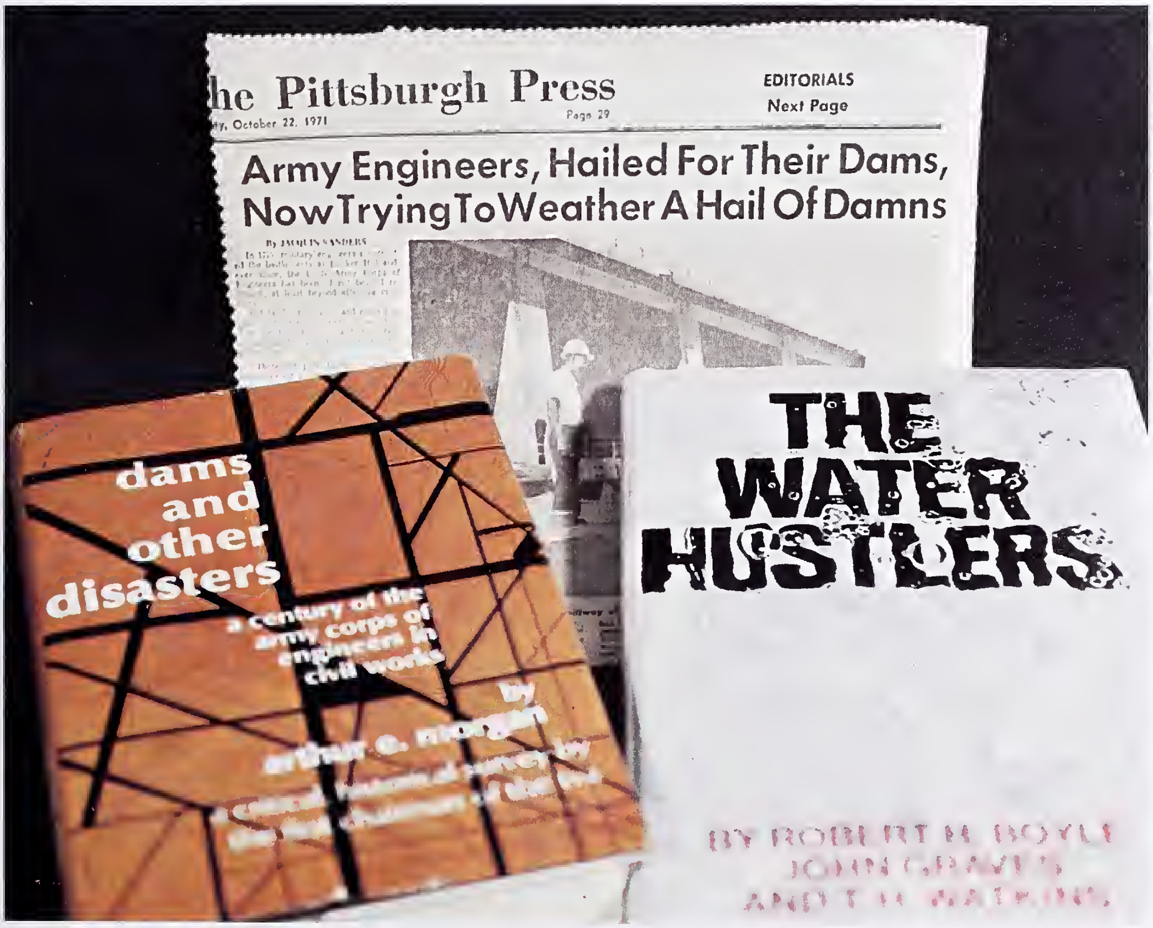
An Act for Environmental Policy signed by President Nixon.

John Franson of the National Audubon Society, an environmentalist group, said in 1971 it was clear the Huntington Engineers were working to help solve some of the environmental problems and had demonstrated an ability to analyze environmental factors skeptically. But his comment was merely driftwood on a sea of discontent, as attacks on the Engineers as enemies of the environment, as acrid as the early twentieth century attacks on the Corps as enemies of forestry and flood control reservoirs, received wide news coverage.

Even Dr. Arthur Maas of Harvard, critic of the Engineers for more than two decades (author of *Muddy Waters: The Army Engineers and the Nation's Rivers*, 1951), was moved in 1971 to defend the Corps against the unbridled attacks. "Somehow one is expected to believe that elected representatives who support Corps projects are 'self-serving politicians,' whereas those who oppose them are noble statesmen," Professor Maass averred in his critique of environmentalist literature. "Somehow one is expected to believe that local interests that oppose Corps projects are right and good, whereas those that promote them are wrong and probably bad, and that although the Corps should be responsive always to the former and never to the latter, the opposite is the case, *quel domage.*"

Major General William L. Starnes, who served as Ohio River Division Engineer during the emotional peak of the environmentalist-exploitation confrontation, warned in 1973 that "con men" were cultivating both sides of the fence:

> Some of our con man friends tell us we should never touch anything more on the earth—preserve it as it is forever. This . . . is palpable nonsense because if we don't use the earth's resources we'll perish or degrade life to mere existence. Unfortunately, on the other side, other con men tell us to pave every acre of land, dam every stream, burn up all the fuel you need. This is equally idiotic as this course of action would leave nothing for future generations.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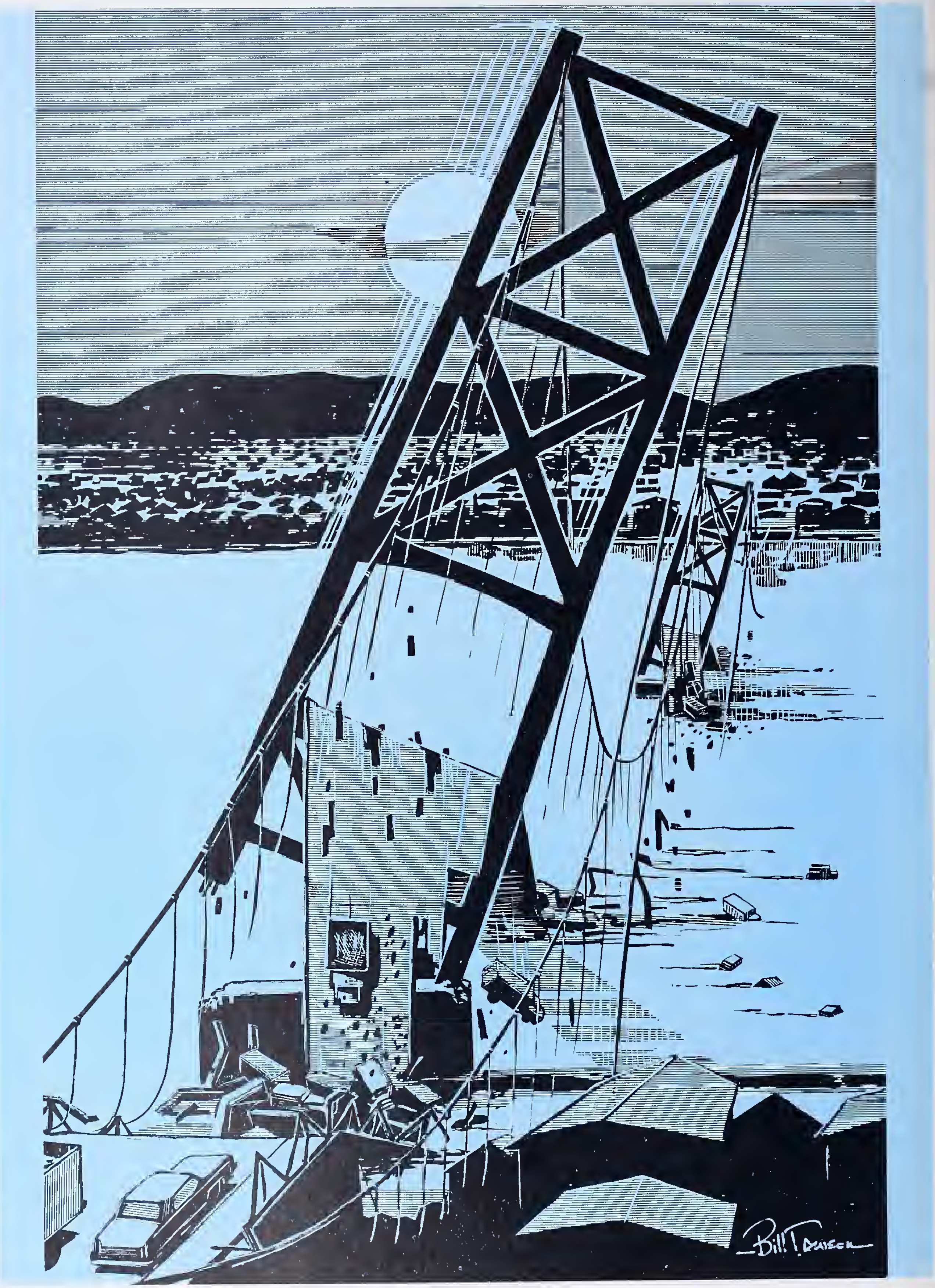
a century of the army corps of engineers in civil works
by arthur e. morgan
THE WATER HUSTLERS
BY ROBERT H. BOYLE
JOHN GRAVES
AND T. H. WATKINS

Contrary to critics the Corps does really care.



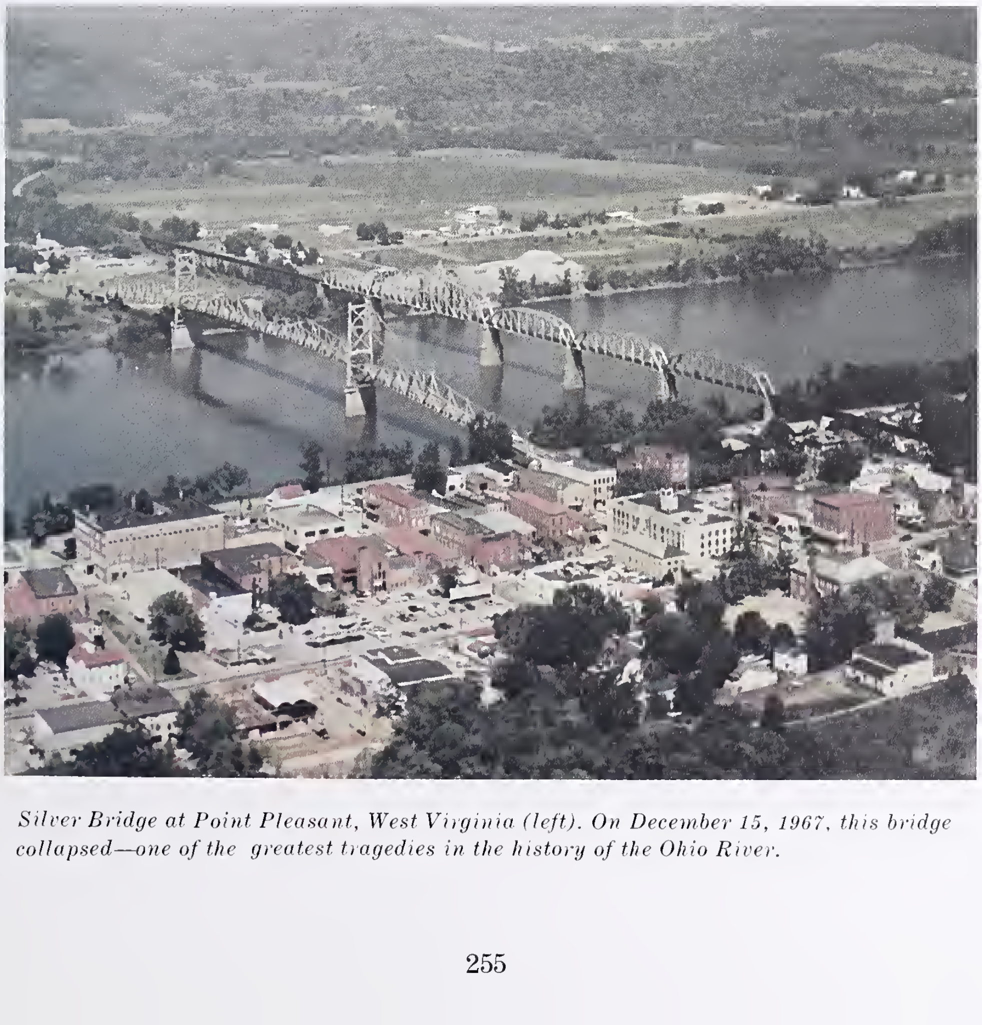
Chapter XV

New Problems in a New Era

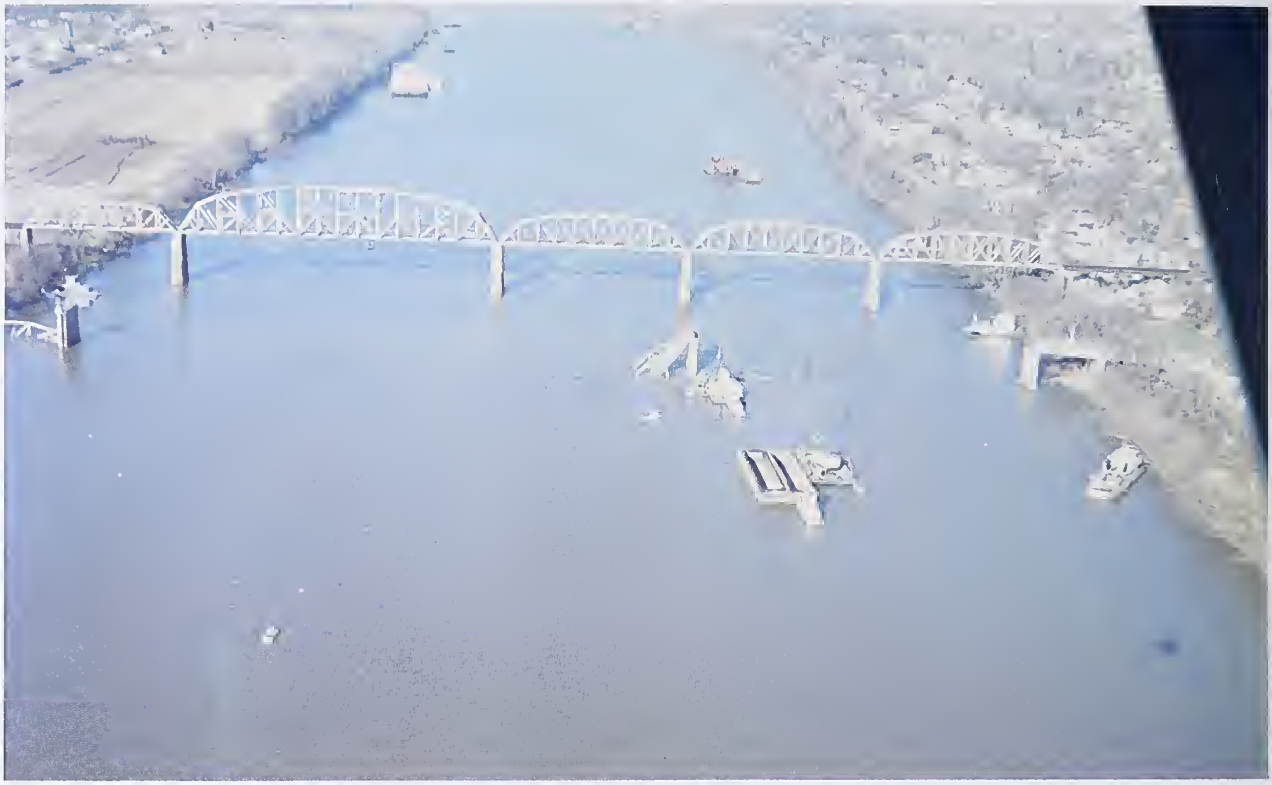
He heard a long, loud rumble like thunder or a sonic boom, but too long to be either, and at the same time the Christmas lights he was stringing around his home at Point Pleasant blinked off and on. After a few moments distraction, hearing nothing further, Bill McCraw continued his work of stringing the holiday lights. Minutes later, a man who worked with him at Racine Locks and Dam, a few miles above Point Pleasant, drove up and told him, with ashen-face, of the fall of the Silver Bridge, while he had been sitting in his car at the stoplight at the bridge approach, waiting for the signal to change.

The bridge—with thirty-three cars and trucks—had collapsed without warning into the Ohio River.

McCraw, resident engineer for the Huntington District at Racine Locks, drove at once to the disaster scene to see what the Corps could do to help. When he arrived at the bridge a boat that had picked up seven men who had survived the fall and escaped from their trucks and cars was just landing. McCraw, who had worked on the Point Pleasant floodwall project seventeen years before and knew that the anchorage of the suspension bars of the Silver Bridge passed through the floodwall, saw at once that the floodwall had not been damaged. He then sketched the physical situation on paper as he saw it. The weather was clear and cold; the river was near flood stage, but silent, except where it gurgled around the fallen bridge. It was clear the Engineers would have to work quickly to make good their responsibilities for maintenance of the navigable channel, for it



Silver Bridge at Point Pleasant, West Virginia (left). On December 15, 1967, this bridge collapsed—one of the greatest tragedies in the history of the Ohio River.



When day dawned on December 16, 1967, forty-six lives, thirty-one vehicles and a bridge were lost. The Corps assumed the responsibilities for cleanup operations and this is the day following the disaster. Salvage work is just beginning.

was completely obstructed, blocking all traffic movement on the stream.

The Silver Bridge plunged to the riverbottom at about 5 on Friday afternoon, December 15, 1967. The Huntington District quickly mobilized to cope with the disaster situation, with the District Emergency Operations Center opening at 7:05 that evening for round-the-clock work during the recovery operations. A few hours later a District Disaster Field Office was opened at the City Ice and Fuel Company dock on the wharfboat *K .W. Tom* on the Point Pleasant waterfront, and the District survey boat, equipped with fathometer, was on its way to sound the riverbottom at the fallen bridge in search of passable channel; none was found.

McCraw, with long experience in heavy construction, knew that floating plant would be needed to remove the bridge sections from the river and called Dravo Corporation, the contractor at Racine Locks, to prepare to send two fifty-ton derrick boats from Racine to the fallen bridge for emergency service.

Local and state government officials, joined by Congressmen Ken Hechler and Clarence E. Miller, Senator Jennings Randolph, and Lt. Colonel Ferd E. Anderson of the Corps, who had flown in from Washington, worked throughout the night to hammer out a plan of recovery operations. The Coast Guard was made responsible for traffic control and dragging operations; the State Police would identify vehicles and victims; the National Guard would move the bodies as they were recovered to a morgue site in Point Pleasant; and the West Virginia Department of Highways would identify and mark each bridge piece as it was removed from the channel so that the bridge could be reassembled on land to determine if possible the point of failure. The Corps of Engineers, because of its experience in heavy construction, its familiarity with river work, and its responsibility for maintenance of navigation, would get the bridge out of the channel and onto the bank.

District Engineer William D. Falck assigned supervision of the work of the Corps at the disaster site to Major Roy A. Brown, Deputy District Engineer, and Bill McCraw. Major Brown was responsible for liaison with the public and the press, while McCraw directed the river operations. At 2 p.m., December 16, work on removal of the bridge was begun by two derrick boats from the nearby M.T. Epling Company, served by the towboats *Panza* and *Trojan*. Two hours later the Dravo derrick boats, accompanied by the towboat *Constructor*, arrived from Racine Locks. The Engineer Towboat *Robert G. West* later brought Corps of Engineer floating plant, including derrick and barges, from the Marietta

Repair Station to the site.

Divers of the Marine Contracting International firm and of the Huntington District, under the direction of Cecil A. "Buck" Hale, lockmaster at Greenup, entered the swift, murky waters to search for the vehicles—hazardous duty, with the bridge members shifting under the pressure of the current. As the divers located the vehicles, the derrick boats moved into place, grappled and caught the trucks and cars, and pulled them out of the water to set them on a barge, where bodies were removed. The bridge sections were taken apart with cutting torches, or by twisting the metal girders with the derrick boat buckets, and removed from the channel for deposit on the West Virginia bank downstream from the mouth of the Kanawha, to be inspected.

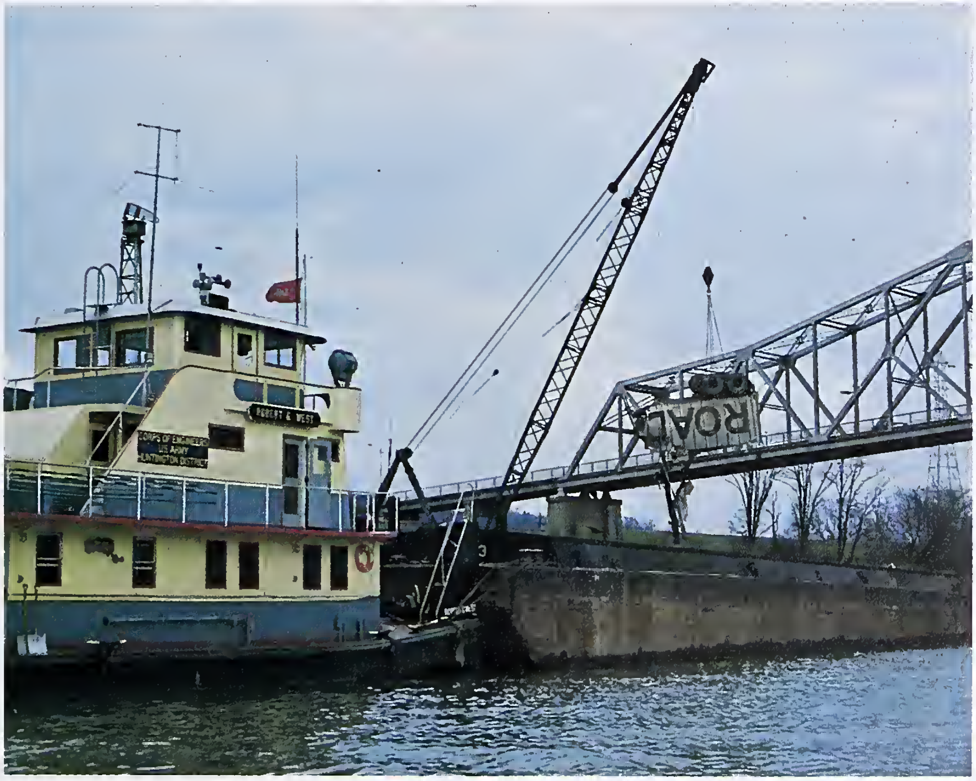
A safe channel was opened on December 21, six days after the disaster, and the waiting river traffic, thirty-nine towboats with 178 empty and 202 loaded barges, navigated through and on their way. The rest of the river was cleared by New Year's Eve, and the Point Pleasant Field Office closed. All told, thirty-one vehicles and the bodies of forty-four victims were recovered—the last at Manchester, Ohio, 120 miles downriver, on February 6. Two bodies were never recovered.

About a hundred Engineer men and women had been mobilized for the emergency recovery operations at Silver Bridge, and, though they worked under unusual pressures and in some highly risky situations, no accidents or losses were suffered. Personal commendations for their roles in the recovery work were later presented to Major Roy A. Brown, William F. McCraw, Gerald E. Ours, William D. Rist, Cecil A. Hale, and William R. Porter by the District Engineer.

Development of Disaster Relief Procedures

Great public attention centered on the Silver Bridge disaster, and public concern later stimulated some salutary bridge inspection legislation, but by 1967 emergency disaster work was more or less preprogrammed in the Huntington District.

The Engineers had been mobilized for emergency rescue and relief work during every major Ohio River flood since 1884, and their services had been utilized in a hundred different disaster situations around the country: the New Orleans yellow fever epidemic of 1873, the Johnstown Dam calamity of 1889, the Texas City explosion of



Corps of Engineers' Towboat, "Robert G. West," salvaging part of a trailer from the river during the six-day clearing and recovery operations.

Another scene showing the massive recovery operations required to reopen the Ohio River channel.

Site on the West Virginia shore below the Kanawha River where the bridge was "reconstructed" in an effort to determine the cause of its failure.

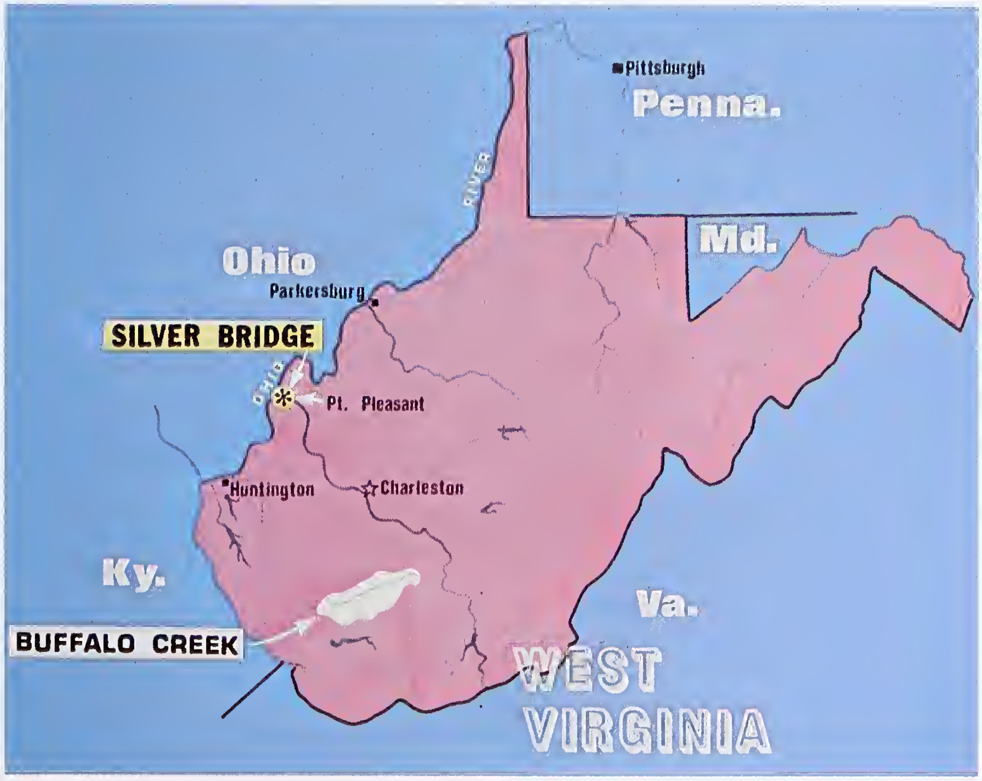
1947, the Great Plains blizzard, "OPERATION SNOWBOUND," of 1948, plus tornado, hurricane, and earthquake disasters throughout the nation.

The Silver Bridge catastrophe was not the first time the Army Engineers in the present Huntington District area had dealt with such a situation. A suspension bridge over the Elk River at Charleston, W. Va., had collapsed on December 15, 1904, sixty-three years to the day before the Silver Bridge incident, and had dropped six wagons and teams into the Elk. Two people were killed and six were injured. Engineer divers and floating plant from Kanawha locks and dams assisted in recovery operations there.

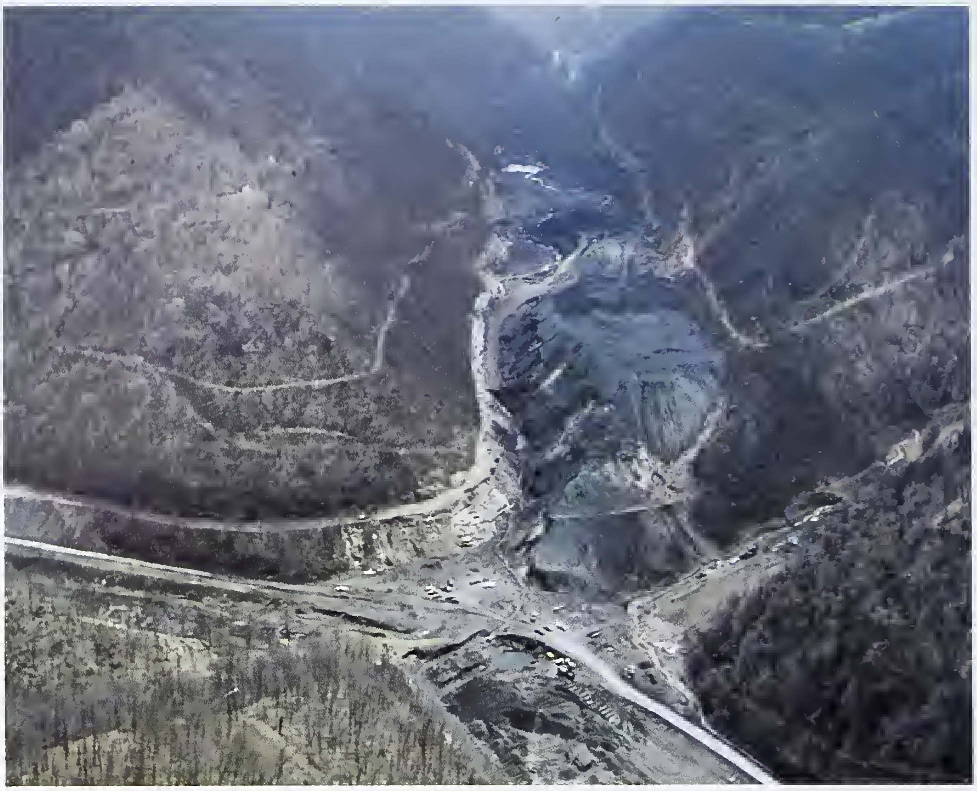
The collapse of the Silver Bridge was related to its unusual design. The bridge, completed in 1928, was of suspension construction, but, in place of wire cables, suspension was provided by two chains of flat steel eyebars, most of them between 45 and 55 feet in length, linked in pairs by massive steel pins through eyes at the ends of the bars. The suspension system consisted of 148 such eyebars. The cause of the collapse was investigated by the National Transportation Safety Board, which examined the bridge parts as reassembled on land. The board's report (1971) found the cause of the collapse to be a "cleavage fracture in the lower limb of the eye of eyebar 330." "The fracture was caused by the development of a critical size flaw over the 40-year life of the structure as the result of the joint action of stress corrosion and corrosion fatigue." The crucial flaw "was inaccessible to visual inspection," it was stated, and could not have been detected by any known method without disassembly of the eyebar joint.

The only other bridge in the United States in which the eyebar principle of design was employed was a "twin" bridge at St. Marys, W. Va., 110 miles above Point Pleasant on the Ohio River, also completed in 1928. The St. Marys bridge was closed and dismantled following the Silver Bridge disaster.

Before 1950 the Engineers were assigned disaster recovery missions by special direction of the President and Congress; each disaster was handled separately at the discretion of the President or Congress, without a systematic disaster policy. In the Federal Disaster Act of 1950, Congress authorized the President, at the request of state governors, to declare the existence of a "major disaster" and mobilize the Engineers and other federal agencies for emergency service without special authorization and funding from



Map showing the location of two of West Virginia's greatest disasters, in which the Corps was involved.



Mine slag dam that failed and nearly wiped out civilization in the Buffalo Creek valley in February 1972.

Congress. National disaster policies and procedures have since been modified on several occasions, as experience seemed to dictate. In 1970, overall coordination of federal disaster activities was assigned to the Office of Emergency Preparedness (OEP), directed by General George Lincoln, who gained his first disaster recovery experience in the Huntington District during the 1937 flood. OEP became the Federal Disaster Assistance Administration (FDAA) in 1973.

The Army Engineers were involved in so many disaster situations by 1940, however, that they had developed systematic plans for disaster operations. Each Engineer District had on hand by 1940 a collection of emergency plans which generally required that in a disaster situation an Emergency Operations Center would be opened in the District office to coordinate recovery work. Disaster Field Offices would be established in the disaster zones, civil works personnel would be mobilized as required for emergency work, and help from other Engineer Districts and units would be requested as needed. As provided under this system, personnel of the Huntington District were often transferred to other Districts for service during emergencies like Hurricane CAMILLE, Tropical Storm AGNES, and some even served on temporary duty during the military emergencies in Korea and Vietnam. Other than floods, however, the two major disasters that occurred in Huntington District were the Silver Bridge and Buffalo Creek calamities.

Death and Destruction at Buffalo Creek

The Buffalo Creek emergency began on February 26, 1972, when a mine slag, or "gob," pile on Middle Fork of Buffalo Creek, a tributary of the Guyandotte, gave way after several days of heavy rain, releasing a seething wall of water to race down the narrow Buffalo Creek valley, leveling mining towns along the stream to the town of Man at the junction of Buffalo Creek with Guyandotte River. One hundred eighteen people were caught and killed by the ferocious, debris-filled flood wave; most bridges were washed out; a thousand homes were wrecked or badly damaged; and Buffalo Creek valley, about the width of a football field at many places, was covered with silt and debris. Colonel Kenneth E. McIntyre, then Huntington District Engineer, said it was the most intensive and complete destruction outside of combat areas that I have ever seen."

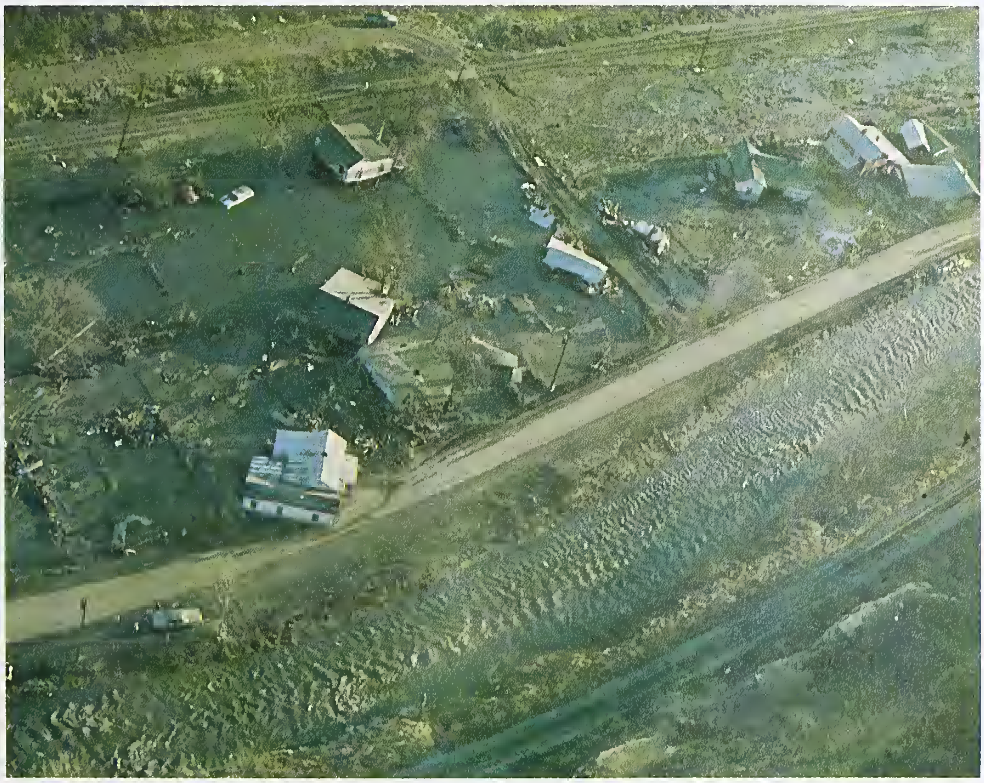
The West Virginia State Police and the National Guard pushed their way over and through the debris up into the valley to rescue the living and recover the dead, but recovery work could not be begun until the one road up the valley was opened to traffic. Colonel McIntyre directed Major John R. Hill, Jr., Deputy District Engineer, and Gaylord Robinette, resident engineer at the R.D. Bailey project, to move the contractors' dozers and other heavy equipment at the Bailey damsite to Buffalo Creek and push up the valley, clearing the road of debris. Pushing, shoving, jamming the gears, the dozers cleared the twisting road in a few days and began moving the wrecked houses, automobiles, and debris out of the way and into piles for disposal.

Once the road was cleared, the Engineers brought in water purification equipment to furnish a safe water supply, portable electric-power generators, and a metal-crushing machine to mash up the automobile hulks for recycling. At the end of the second week's work, National Guard units were withdrawn, and the Engineers were assigned the task of recovering any bodies that remained.

One urgent phase of the mission was the provision of temporary shelter for the homeless, and the state of West Virginia contracted with the Engineers to clear sites and install trailer pads and utility lines. With the assistance of a hundred pieces of construction equipment and 190 contractor personnel and local workmen. Major John Hill and the Engineers working along Buffalo Creek had the first trailer sites, complete with sewage, water, and electric lines, ready for occupancy in a week. By March 16, 233 trailer pads were ready and the Department of Housing and Urban Development (HUD) had 156 trailers in place. The Engineers also built and operated a sanitary landfill for contaminated foods and four landfill disposal sites for nonburnable debris.

In the wake of the Buffalo Creek disaster, the Huntington Engineers were directed to study restoration of Buffalo Creek valley, including waste treatment and water supply facilities, and channel rectification and regulation of floodplain development.

Because citizens living below dams and slag piles in other valleys were worried by the Buffalo Creek catastrophe, Congress directed the Engineers to undertake a national program of inspection of dams. There were well over 30,000 dams in the United States, of which only 800 had been built by the Engineers and other federal agencies—the remainder had been built by state and local governments and private companies and individuals, often without much supervision. The inspection program was small comfort to the victims of Buffalo Creek, but the program might do much to prevent the occurrence of similar disasters.



The community of Braeholm in Buffalo valley, showing the devastation after the "flood wave" had passed.

WE THANK YOU CORPS OF ENGINEERS
!PLEASE! Build US A BRIDGE
PA!

Citizens thanking the Corps for building a bridge across Buffalo Creek.

Reconstruction at Buffalo valley. Bridge at Becco being returned to its foundation—one of the few that could be used after the flood.

Buffalo school trailer site—one of several sites used to provide homes to families displaced by the disaster.

Organizing for Civil Defense

The talents of the Engineers and their swift response in emergency situations through their widely dispersed, decentralized organization brought them a wide variety of planning, engineering, and construction assignments in the decades following the Second World War.

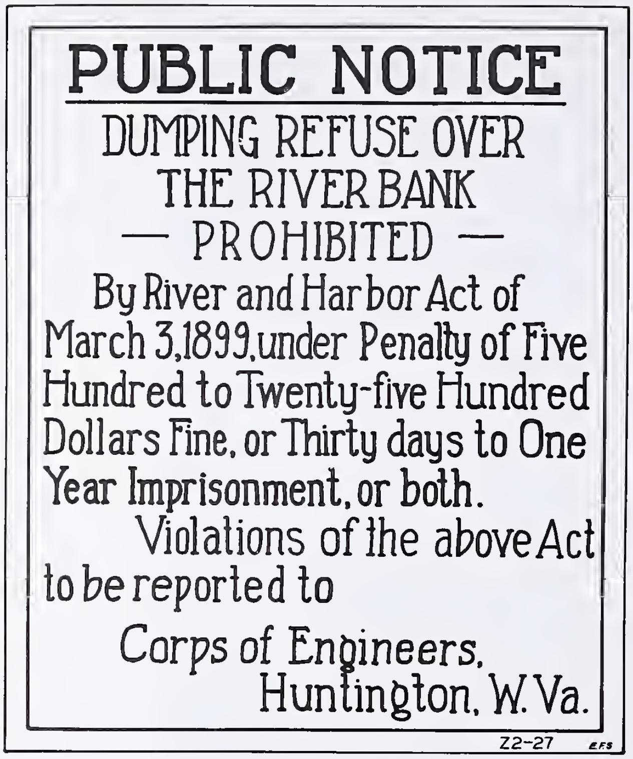
President John F. Kennedy, concerned by the threat of sudden attack with nuclear warheads delivered by missiles, placed the direction of the Civil Defense program under the Secretary of Defense in 1961 and ordered the rapid development of warning systems, national fallout shelters, and postattack recovery plans. The Corps of Engineers civil works organization, in close contact with local situations, was directed to perform this work in a hurry, for at that time atomic war over such issues as the Berlin Wall or Cuban missile bases seemed a daily threat.

The staff of the Huntington District and contracting architect-engineer firms surveyed the states of Ohio and West Virginia to locate potential fallout shelters that could shield against radiation, marked the best sites, and prepared the sites to receive stores of emergency supplies. The Engineers then assisted in developing Community Shelter programs and emergency warning and broadcast systems. An inventory of construction equipment and contractors who might be called upon during atomic disaster was completed, and contingency plans for postattack recovery—restoration of utilities and transportation, heavy rescue work, debris clearance, mass burials, radiation detection, decontamination, and damage assessments—were prepared.

Public interest in the Civil Defense program had faded by 1970, and the Civil Defense Support activities in the Huntington District Office were transferred to the Ohio River Division. Recovery from nuclear attack was one disaster mission the Huntington Engineers hoped they would never have to undertake; nevertheless, should it come, they would be prepared.

Combatting Water Pollution

By 1970 the Huntington Engineers were also deeply involved in recovery efforts from the creeping disaster known as water pollution. Sparked by the warnings of environmentalists, intense public concern about the water pollution disaster had been translated into landmark legislation by 1970. But in the opinion of the Engineers, who lived and worked on the rivers most of the time and who had observed the steady deterioration of water quality for over a century,



PUBLIC NOTICE

DUMPING REFUSE OVER
THE RIVER BANK
— PROHIBITED —
By River and Harbor Act of
March 3,1899,under Penalty of Five
Hundred to Twenty-five Hundred
Dollars Fine, or Thirty days to One
Year Imprisonment, or both.
Violations of the above Act
to be reported to
Corps of Engineers,
Huntington, W. Va.

Z2-27 EFS

effective antipollution legislation had been delayed far too long.

The Refuse Act of 1899 had given the Engineers authority to prevent the obstruction of navigable rivers, but the legislation had not been construed by the courts as extending to water pollution. The Engineers were able, however, to "stretch" the law on occasion. In 1910, for example, West Virginia sought to stop iron furnaces along New River in Virginia from discharging iron oxides into the stream—the oxides flowed down the New River into West Virginia and the Kanawha—and the Engineers found a way to stop them.

In testimony at a public hearing in Charleston on June 25, 1910, Assistant Engineer Thomas E. Jeffries, in charge of the Charleston Suboffice, recalled that when he first saw the Kanawha in 1855 the stream was clear as crystal. He remembered swimming in the river with open eyes and gigging for fish that were visible fifty feet away in the clear water. But since 1895, Jeffries testified, the Kanawha had been murky. This testimony was confirmed by many other witnesses, one of whom was Governor W.A. MacCorkle of West Virginia, who declared the Kanawha was a "foul sewer, abhorrent to the eye, and absolutely destructive of all life within it and useless to the community through which it flows."

Because the iron oxides clogged steamboat boilers, the Engineers viewed this pollution as an obstruction to navigation and took the legal action necessary to prevent further iron oxide discharges. Governor MacCorkle told the Engineers: "Your action has been a subject of universal rejoicing on the part of all the citizens"; and Congressman Adam Littlepage declared: "This situation has been a nightmare to our people for nearly twenty years, and by your course you have incurred their everlasting gratitude."

But the Engineers were seldom able to use the Refuse Act to reduce pollution. When an individual complained about the discharge of acids into the Muskingum in 1923, the Huntington District Engineer advised him the Engineers lacked the authority to stop it, and explained:

> This office well appreciates the injurious effect of acid discharges not only on fish life, but also upon property of many classes, and recognizing that existing Federal laws are ineffectual to remedy or prohibit the pollution of waters by oils, acids and other wastes, has given such aid as it could to the enactment in Congress of appropriate laws, several bills to prohibit the pollution of waters having been under consideration but so far none has been enacted into law.

The deterioration of water quality on the Ohio River was also a subject of concern to the Engineers and other federal agencies at an early date. A.H. Horton of the U.S. Geological Survey said in 1908 the flow of the Ohio River at low water stages was only about a fifth of the flow required to render the raw sewage entering the river inoffensive, asserted that the river was no longer suitable for use as municipal water supply, and urged enactment of corrective federal legislation. States bordering the Ohio met at Wheeling in 1909 to attempt to organize an interstate commission to coordinate state water pollution legislation, but the commission accomplished little and Congress did not act on the water quality problem until 1924.

The Oil Pollution Act of 1924 directed the Engineers to investigate the pollution of navigable waters, and under this authority the Engineers reported in 1926 that game fishing on the inland waterways was being destroyed by pollution and that the problem constituted a major threat to "public health, sports, and various forms of outdoor recreation." The section of the report dealing with the inland waterways was not acted upon by Congress, however, and within a few years the report had generally been forgotten.

Studies of Ohio River water quality were conducted by the U.S. Public Health Service (PHS) in 1914 and 1924, and the PHS reported in both instances that the stream was in sad condition, especially in the section between Huntington and Portsmouth where raw wastes from Huntington, Ashland, and Ironton were flowing untreated into La Belle Sewer. The PHS reports were also largely ignored until a serious threat to public health occurred in 1931 as a result of massive pollution.

During the lengthy drought of the summer and autumn of 1930, the low river stages uncovered the open sewer outlets along the river, obnoxious tastes and odors in water supplies obtained from the rivers became noticeable, and epidemic gastroenteritis ravaged the people of Charleston on the Kanawha. Winter rains relieved the drought, but also flushed sludge from the Kanawha into the Ohio, and epidemic gastroenteritis spread successively to downstream communities, striking at Huntington, Ashland, and Ironton in January 1931 and at Cincinnati and Louisville in February.

The course of the disease clearly indicated that it had been borne downstream by the rivers, and in the wake of this near disaster chambers of commerce at several Ohio valley cities and the Ohio Valley Improvement Association established stream pollution committees to pressure Congress for remedial action. These groups achieved partial success in 1936 and 1937, when Congress authorized the organization of a regional compact among Ohio Valley states to deal with municipal waste pollution, approved a mine-sealing project to reduce the volume of mineral acids entering Ohio River tributaries, and funded an areawide pollution study in the Ohio basin.

"The Ohio River," said Congressman Brent Spence of Kentucky, "by reason of the great volume and variety of industrial waste and the immense volume of domestic sewage that it receives and the fact that at many seasons of the year there is but a small volume of water, in my opinion should be the great national laboratory where this problem of such vital interest to the people may be solved." Congressman Spence's comments, and those of many other citizens of the Ohio valley, made it apparent to Congress in 1937 that federal action on Ohio River pollution was required. Congress was willing to approve studies of the problem to determine the optimum remedial steps, but was not certain what federal agency could best perform the study—both the Public Health Service and the Corps of Engineers wanted the job.

The Chief of Engineers said the Corps should perform the study because:

> This organization is entirely familiar with the streams involved and possesses a large amount of data relating thereto which is essential in the determination of the best methods for pollution

Pollution—a problem both in the rivers and along their banks.

control. The feasibility of using this organization becomes apparent when it is realized that the solution of the pollution problem is an engineering matter. It is closely related to the hydrology of the streams with particular reference to the increase in their low water flow through the operation of dams and reservoirs authorized for flood control and for navigation.

President Franklin D. Roosevelt resolved the issue by directing the Engineers and the Public Health Service to conduct a cooperative study, under the general direction of a committee composed of Ralph E. Tarbett of the Public Health Service, Consulting Engineer Abel Wolman of Baltimore, and Generals Max C. Tyler and Thomas M. Robins of The Corps of Engineers.

The Ohio River Pollution Study, the first of its kind, was begun in 1937 and completed in 1943. In the Huntington Engineer District, water samples and data were collected at each lock and dam, and Engineer quarterboats were furnished the PHS to serve as mobile laboratories. The information gathered in the Huntington District and in the other Engineer Districts in the Ohio River Division was collected, tabulated, analyzed, and printed in 1943. General Eugene Reybold, Chief of Engineers, described the precedent-setting study as the "most complete and comprehensive examination ever made into the sanitary conditions of a major river and its tributaries."

The 1943 report presented a dismal picture of water quality deterioration throughout the Ohio River basin. In the Huntington District, for example, acid-drainage from mines was reaching serious proportions, bacterial pollution was discovered in the public water supplies at Ashland, Ironton, and Portsmouth, and domestic-industrial wastes were overwhelming the absorbent capacity of the Kanawha near Charleston, of the Tuscarawas River in the Muskingum watershed, and of the streams in the lower Scioto River basin. "The effects of stream pollution are widespread," the report concluded, for "in addition to direct, economic damages, there are other, less tangible damages, of a more or less psychological nature. For example, aquatic rec-

Oil spill on a bank of the Ohio River.

reational facilities convenient to large population centers are of value to public morale, may lessen juvenile delinquency, and in other ways contribute to the general public welfare."

The Engineers and the Public Health Service recommended the Ohio River Valley Water Sanitation Compact be formed for uniform control of interstate water pollution, the continuation of the PHS research and public education program, the sealing of abandoned mines to reduce acid drainage, and the operation of Engineer flood control reservoirs to increase low flow for the dilution of acid and organic pollution. Their report, completed in 1943 in the midst of global war, received little public attention, but Congress eventually implemented most on its recommendations.

Low-flow augmentation to abate pollution and improve water quality was recognized by Congress in the postwar era as a viable Engineer reservoir-project purpose, and provision for low-flow augmentation was built into many of the Engineer reservoirs. This project function was sometimes decried by critics as mere "pollution dilution," but its value was vividly illustrated during drought years. In the autumn of 1963, for example, more than 50 percent of the entire flow of the Ohio River was supplied by releases from upstream reservoirs, and without this increased flow conditions would have been quite serious, even hazardous to public health.

The Ohio River Valley Water Sanitation Compact (ORSANCO) was at last formally approved by valley states in June 1948, and efforts were begun to persuade and compel riverside communities to install adequate waste treatment facilities. When the Ohio River Valley Water Sanitation Commission (ORSANCO) was established in 1948, only 1 percent of the cities and towns in the valley had adequate waste treatment plants—the other 99 percent dumped raw sewage directly into the streams. With the assistance of federal funds furnished under the provisions of the Water Pollution Control act of 1948, city after city, town after town installed treatment facilities, and within twenty years after ORSANCO was formed, the ratio had been reversed—99 percent of valley communities had built at least minimum quality treatment plants. By 1965, ORSANCO was even turning its attention to curtailing discharges of untreated wastes from boats plying the Ohio, an action that would have been laughable in 1948 when the Ohio was described as the "most monstrous open sewer in the land."

The quality of Ohio River water had noticeably improved by 1973, and the Environmental Protection Agency was talking about "zero" pollution by 1985. Arnold Coyer, river diver for the city of Huntington for many years, declared in 1973 that he, in his journeys to the bottom of the river, had observed the river gradually clear. A Huntington boater asserted: "When I was a kid, I couldn't see my hand in front of me. Now it's greatly improved." These personal observations were confirmed by the Environmental Protection Agency, which reported in 1972 that the game fish population in the Ohio had doubled from 1959 to 1971 and that swimming and other water-contact sports on the Ohio, even at Huntington, had become safe.

Recreational use of the Ohio on the deep slackwater pools formed by the modern locks and dams was burgeoning by 1976. Port cities like Pomeroy, Portsmouth, Marietta, Gallipolis, and Huntington had even begun to view the Ohio as something to be proud of and were staging annual regatta and river recreation festivals on the riverfront. Further reductions in pollution levels were planned, but by 1976 it was fair to view pollution control on the Ohio as a success, proving that degradation of water quality attending industrial and urban growth was not necessarily an irreversible process.

The Engineers made releases from reservoirs to maintain riverflow for water supply and pollution abatement, and the Engineer navigation dams were operated to create turbulence as water fell over the dams to increase oxygen content. Other than these practical contributions the Engineer role in water quality improvement until 1969 was limited largely to advisory studies. Then, through a series of legal actions carried to the Supreme Court, the Engineers won a decision which allowed enforcement of the 1899 Refuse Act not only to prevent obstructions to navigation but also to prevent the discharge of untreated pollutants into waterways.

President Richard M. Nixon issued an executive order in late 1970 directing the Engineers, under the new court interpretation of the Refuse Act, to require persons or companies discharging

NATIONAL PLANNING OBJECTIVES FOR WATER RESOURCE PROJECTS

NATIONAL ECONOMIC DEVELOPMENT

REGIONAL ECONOMIC DEVELOPMENT

QUALITY OF THE ENVIRONMENT

SOCIAL WELL-BEING OF PEOPLE

National planning objectives for water resource projects.

effluents into navigable waters to obtain federal permits by July 1, 1971. To obtain these permits, those responsible for the discharges would have to meet high water quality standards established by the Environmental Protection Agency (EPA).

The Huntington Engineers launched their survey of industrial discharges in late 1970; and in 1971 the District initiated legal actions against those who failed to comply with the requirements of the law. By 1973 the Huntington District had forwarded a hundred alleged violations to the Justice Department for prosecution and had obtained forty-two convictions. As provided in the Federal Water Pollution Control Act Amendments of 1972, EPA took over the discharge permit program in 1973, but the Engineers had made a fine start in reducing water pollution. They continued to enforce the 1899 Refuse Act as it applied to the obstruction of navigable streams.

Comprehensive Planning Comes to the Fore

Critics of the Corps during the 1960's commonly advocated redirecting the principal thrust of the Engineer water resource program from flood control to the solution of water quality problems. Congress was not willing to relegate flood control planning and construction to the back shelf, but was interested in applying Engineer expertise to environmental repair through improved wastewater management planning and directed the Engineers to perform several pilot studies. The Engineers studied wastewater management systems throughout the world and tested systems that appeared to have some potential in the metropolitan Chicago, Detroit, San Francisco, and Cleveland areas, and in the Merrimack basin in New England. The Huntington District was thrust into the forefront of this program when Congress approved two wastewater management studies, in conjunction with other facets of urban water problems, in the District in 1972: one in the Charleston, W. Va., area; the other in the Huntington, Ashland-Ironton-Portsmouth area, taking in parts of three states: West Virginia, Kentucky, and Ohio.

Funds for a projected three-year cooperative study of flood control, floodplain management, recreation, wastewater management, and other water and related land resource problems in the urban Tri-State Area became available in late 1973, and the Huntington District launched a regional planning program designed to improve water quality and to contribute to the solution of other pressing urban problems. It appeared in

THE TRI-STATE:
WE'RE JUST BEGINNING
WATER FOR TOMORROW IN THE KANAWHA VALLEY
URBAN ST
solves
pu
What IS Urban Studies ?
Let Us Tell You...
WATER QUALITY For The Tri-State
WATER RESOURCES NEEDS:
Huntington Metropolitan Study Area
Charleston Metropolitan Region
WE'RE JUST BEGINNING

Literature distributed by the Corps in the Huntington District on water resource needs.

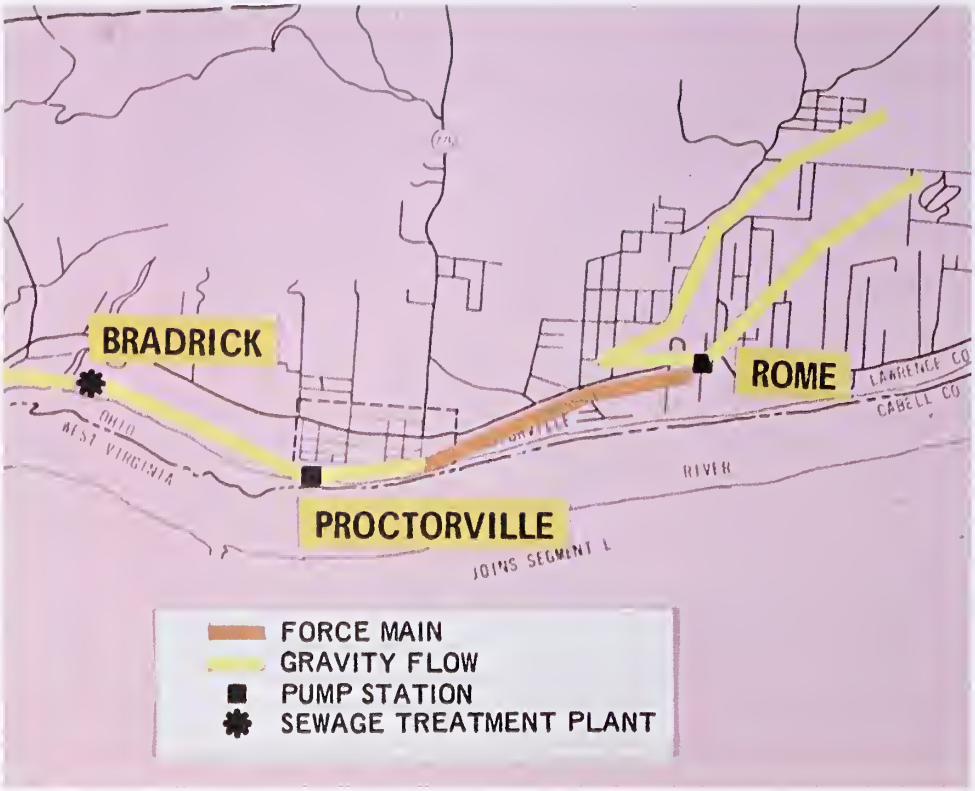
Volunteer workers cleaning up at Twelvepole Creek near Huntington during the West Virginia Wild Rivers' Campaign.

1976 that the Charleston study might be discontinued.

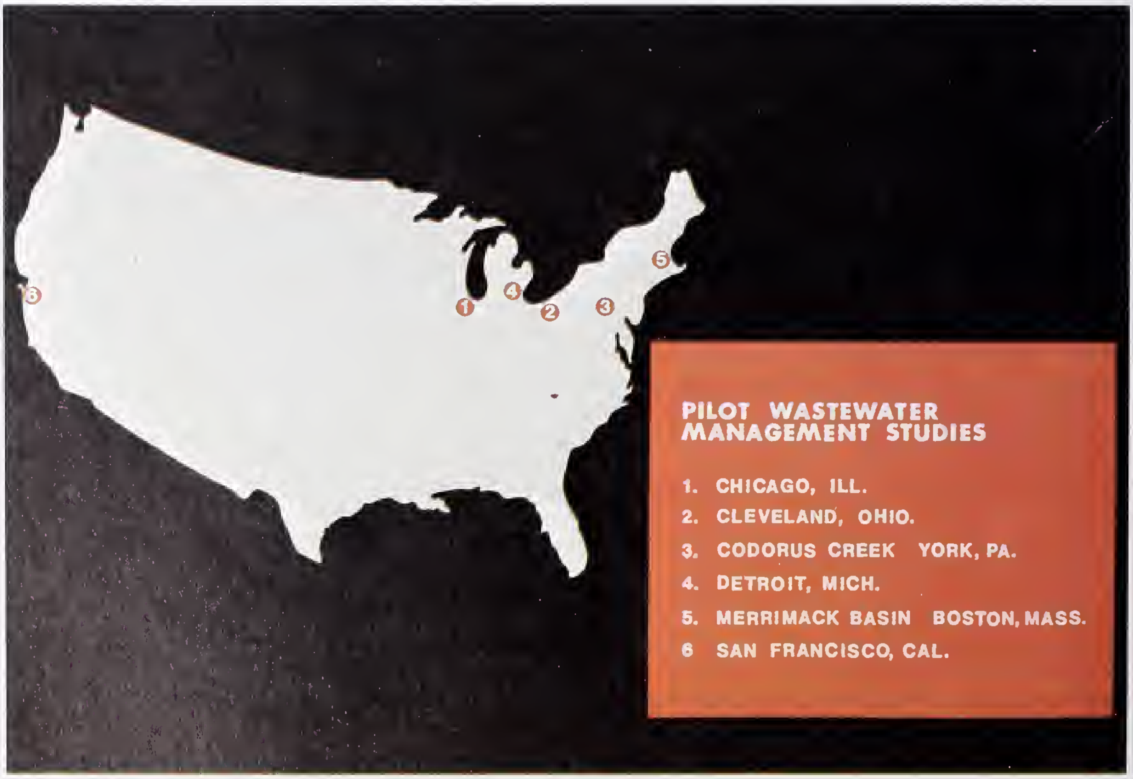
Planning studies consumed an increasing portion of the attention of the Huntington Engineers after 1960. The Engineers initiated studies of several river basins and their water resource needs about 1962, and these investigations became part of the studies undertaken by the federal-state River Basin Committees established, as authorized by the Water Resources Planning Act of 1965, to analyze developmental needs in major river basins. Comprehensive planning of all different varieties of programs designed to meet water and related land resource needs had been advocated since the Progressive Era of the early twentieth century by national leaders who believed the separate programs implemented by several agencies—the Corps of Engineers, the Department of Interior, the Soil Conservation Service of the Department of Agriculture, state governments, and others—led to piecemeal, sometimes haphazard, development. Proponents of comprehensive planning frequently proposed amalgamating all agencies involved in the construction of public works in a huge "Department of Public Works," or perhaps a "Department of Natural Resources." Such proposals were not favorably received by Congress, but Congress nevertheless, thought the concept of comprehensive planning of water resource development had merit, and the River Basin Committees authorized in 1965 represented a step toward that end.

Engineer officers had not always viewed the concept of comprehensive planning with favor, and in the early days there were some who believed such planning impossible. The Chief of Engineers issued a confidential order to District Engineers in 1913 directing them to initiate comprehensive surveys. In most cases the District Engineers responded with elaborate reports, but Major Lewis H. Rand, Cincinnati District Engineer, replied:

> A survey which would contain *all* the information with the absolute accuracy that seems to be desired in some instances would be so expensive in time and money that no one would be willing to start it with the positive knowledge he would have that it would never be available for his own purposes and would cost more than those purposes would justify. Then, too, such a survey would result in so dense a haze of knowledge that the ordinary wayfarer would totally lose his way himself long before reaching the conclusion towards which his entrance was directed . . . . To obtain the results which all can see are desirable involves an immensity of detail totally beyond the grasp of the human mind in its present state of evolution and a concentrated attention and ability which, if exis-


BRADRICK
ROME
LAWRENCE CO
CABELL CO
OHIO
WEST VIRGINIA
RIVER
PROCTORVILLE
JOINS SEGMENT L
FORCE MAIN
GRAVITY FLOW
PUMP STATION
SEWAGE TREATMENT PLANT

Areas in the United States where pilot studies on water resource development were made.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PILOT WASTEWATER MANAGEMENT STUDIES
1. CHICAGO, ILL.
2. CLEVELAND, OHIO.
3. CODORUS CREEK YORK, PA.
4. DETROIT, MICH.
5. MERRIMACK BASIN BOSTON, MASS.
6 SAN FRANCISCO, CAL.

An area in the Huntington District that received a comprehensive planning study for water resource development.

tent, could procure much fuller rewards for its exercise in other fields of activity.

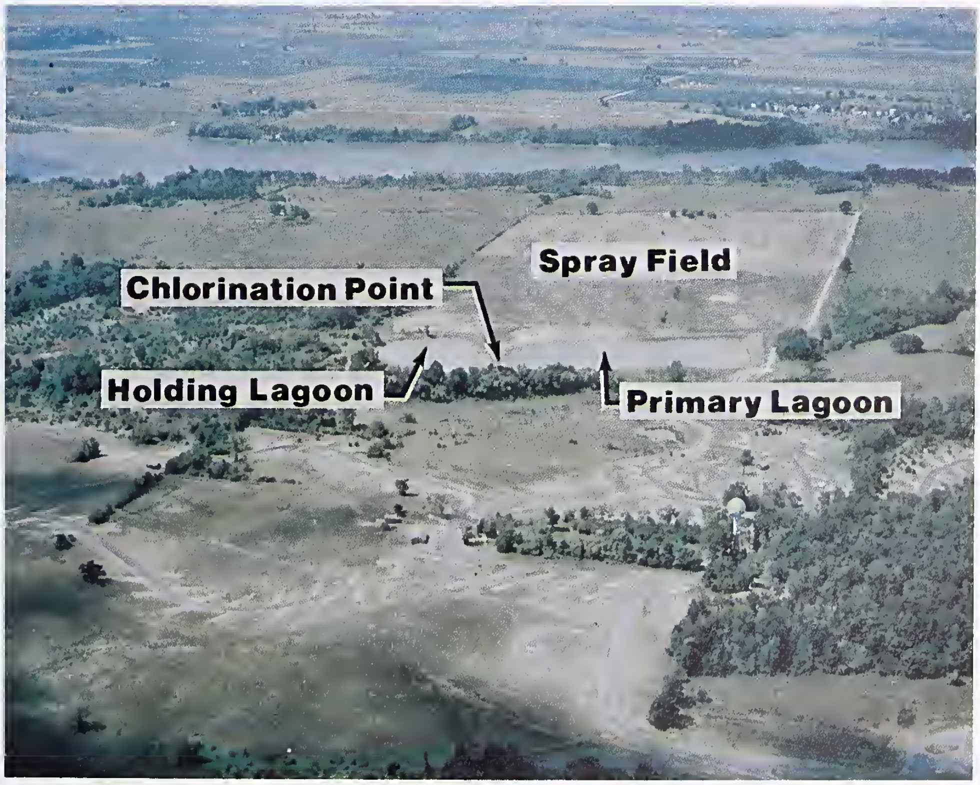
Notwithstanding Major Rands' skepticism in 1913, beginning with the "308 Reports" undertaken in 1927, the Engineers gradually accumulated detailed, precise data and developed methods of analysis that formed a firm foundation for the comprehensive planning studies begun fifty years after Major Rand said it could not be done.

Comprehensive planning for the development of Kanawha River basin water resources was begun by the Engineers in 1962 and became a joint effort of the states of Virginia, West Virginia, and North Carolina, and the federal Departments of Agriculture, Interior, Commerce, and Health, Education, and Welfare, plus the Federal Power Commission, with the representative of the Corps of Engineers acting as chairman of the study. The study was expanded during its course to include environmental issues and regional economic growth in addition to water resources.

The planning group, known as the Kanawha River Basin Coordinating Committee, developed a set of proposals by 1971 designed to meet the immediate needs of the Kanawha valley, with projected growth until the twenty-first century. The "early action" plan proposed by the committee called for protective acquisition of land to preserve scenic areas, construction of sixteen upstream watershed projects, expansion of recreational facilities, improvement of seventy-five waste treatment plants, navigation modernization, completion of sixteen floodplain information studies, and the building of ten large multipurpose reservoirs.

Sharing in the Appalachia Program

The Huntington Engineers were also heavily involved in planning the revitalization of the chronically depressed economy of Appalachia, because water resource development was viewed as one method of breaking the chains of poverty that seemed to bind the region. Harry Caudill, the Appalachian author, told the Senate Committee on Public Works in 1964 that the forests of Appalachia had been systematically plundered for lumber, its mountains had been slashed open for coal, and torrents of sulphur-laden water draining from open coal seams contaminated streams, killed fish, and multiplied water quality problems in a half dozen states. But exploitation of the rich resources of Appalachia had not much benefited its people, declared Mr. Caudill, and



Wastewater Treatment Facility constructed by the Corps at Deer Creek Lake, south of Columbus, Ohio.

A stripmining area showing denuding of the beautiful West Virginia hills.

bleak poverty had become a permanent condition of life in the region. In the opinion of Mr. Caudill, water resource development and research would be an essential element of the redevelopment of Appalachia.

Because it was believed that water resource development could be a key to relieving the employment and economic crisis in Appalachia, the Appalachian Regional Development Act of 1965, part of the "War on Poverty" program of the Lyndon Johnson administration, directed that water resource plans designed to stimulate regional development be formulated. To carry on this work, the Office of Appalachian Studies was established at the Ohio River Division in Cincinnati, and Engineer Districts in the Appalachian region were assigned responsibility for portions of the Appalachian water resource planning work. Other interested federal agencies and the involved states cooperated in the studies and report preparation.

The Huntington District, covering the heart of Appalachia, found that conditions in the region were just about as bad as Harry Caudill portrayed them, though the District used less graphic prose than had Mr. Caudill in its report:

> The Appalachian area within the Huntington District has experienced an increase in capital intensive manufacturing as well as a rapid decrease in mining employment in the years following World War II. Millions of dollars have been spent for the construction of chemical and other capital intensive plants as well as for the installation of mining equipment. However, the increase in industrialization and automation has been greater than the increase in employment. The plants and mines are highly mechanized, and consequently employ fewer men in proportion to capital investment. Many areas in the District have experienced severe declines in employment. Nevertheless, while the new investment has been beneficial to the area's economy, the community does not enjoy a level of living comparable with the national level.

The Appalachian Studies represented an effort to plan something to boost Appalachian economic conditions—and the planners made a radical departure from traditional water resource planning procedures. Instead of measuring immediate needs and projected future needs on the basis of historical growth patterns, the Appalachian Studies sought to locate growth potentials and develop public works projects that would stimulate new economic activity, new industry, new jobs, and new prosperity. These precedent-shattering studies were completed and a twenty-five volume report printed in 1970. But national concern for the problems of Appalachia had evidently waned, for the published report met with but little fanfare, and little action was taken on its recommendations. The chief question in 1976 was whether the Appalachian Studies were a harbinger of the future of water resource development, or whether the report was an anomaly, like the Windom Committee Report on Transportation-Routes to the Seaboard of 1874, that would be shelved and largely forgotten.

Proponents of comprehensive river basin planning and development asserted that this planning method offered great promise, could curb the exploitation of one area by another, and could introduce greater measures of economic, social, and political democracy. But except in rare cases, such as the Muskingum Conservancy program, fifty or more years have usually elapsed between the formulation of broad water resource plans and their full implementation. The student of Huntington District history during its centennial in 2022 may be better able to assess the results of the comprehensive plans completed during the 1970's.

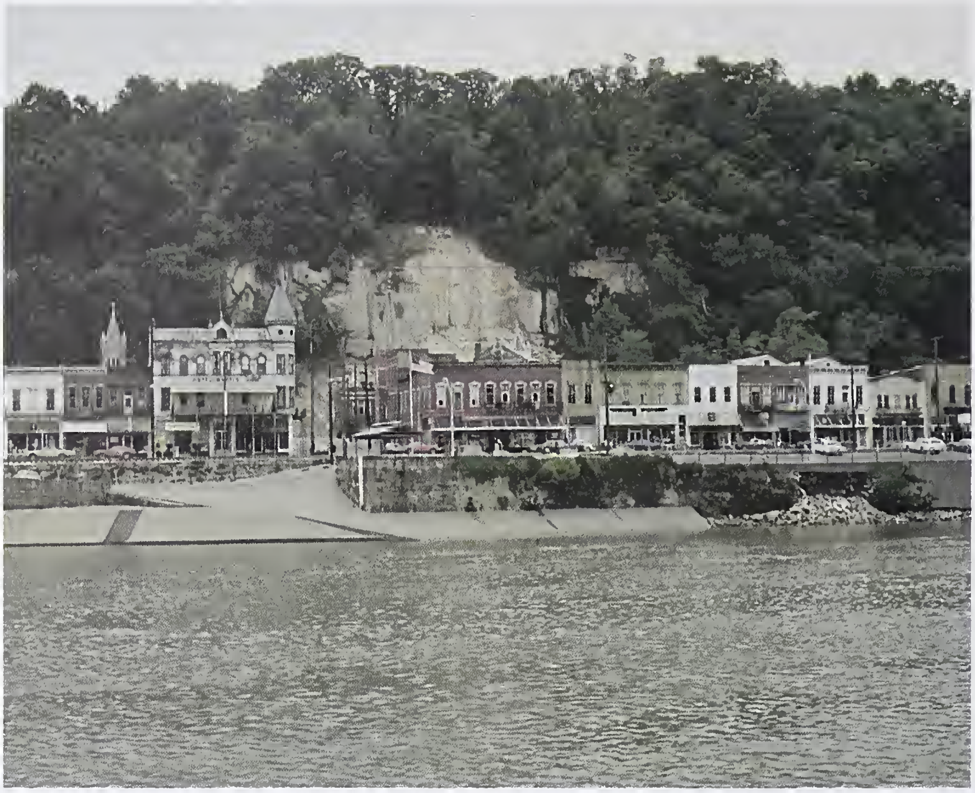
An Anniversary View

Emergency disaster operations, water quality improvement, urban wastewater studies, Appalachian Studies, comprehensive water resource planning—the mission of the Huntington District was expanding in several directions when it observed its golden fiftieth anniversary in 1972. The Corps of Engineers and the Huntington District had become nothing less than an all-purpose organization, whose services were utilized by the nation whenever expert planning, engineering, and construction were required.

As another example, the newly organized United States Postal Service requested the Engineers to undertake construction and modernization of postal facilities in 1970. This new mission placed the Engineers somewhat in the position of a general contractor, for they had to operate within cost limits set by the Postal Service, which in turn was seeking to improve service and efficiency to the point where its income and expenditures would balance.

Postal construction performed by the Huntington District during the early 1970's chiefly involved the renovation and expansion of old buildings, a task fraught with many difficulties, because some of the post office buildings were very old. The District renovated postal facilities at Pomeroy and Columbus, Ohio, and at Mount Hope, Fayetteville, Huntington, and Charleston,

Levisa Fork of the Big Sandy River above Fishtrap Lake. Dark areas on banks show mine dust sedimentation known as silting.



Showing in the background is the rockcliff that threatened to demolish the Post Office at Pomeroy, Ohio. This overhang was removed by the Corps by hand.

W. Va., and performed the work efficiently and on schedule.

The most interesting of the problems encountered was an overhanging rock cliff that threatened to topple down and demolish the post office at Pomeroy. Bill McCraw, Chief of Construction for Huntington District in 1974, said the rock cliff behind the Pomeroy post office could not be reached with heavy construction equipment and blasting would have released cascades of stone on the buildings below. In these circumstances the Huntington Engineers and the contractor, Paul Coffey Construction Company, decided to remove the projecting rock with handtools. Tools were carried by hand from the nearest road to the worksite, where the overburden was removed with shovels and the workmen, wearing safety belts anchored by ropes, drilled holes into the cliff with hand-held air drills. The rock was segmented with hydraulic rock splitters, then worked free with pinchbars and dropped harmlessly into a trench dug at the base of the cliff. In spite of the high risks of the work, there were no accidents, and the buildings below lost not a single windowpane.

The multifaceted missions assigned to the Huntington District substantially increased the size and complexity of its operations. When the District opened in 1922 in the Deegan and Noonan Building, it had the single mission of navigation improvement, handled by a staff of twenty-five people in the District Office and fewer than 200 men at the locks and dams. At its fiftieth anniversary in 1972, the District Office was located in the modern Federal Office Building at Fifth Avenue and Eighth Street in Huntington, into which it had moved in 1960, and it employed 929 men and women. During its first half century of operation, the District had completed and placed in operation about $622 million worth of public works projects—twenty-nine dams and lakes for flood control and multiple purposes, eight modern locks and dams on the Ohio and Kanawha rivers, twenty-three local flood protection projects, and a large number of smaller stream clearance and bank protection projects.

When Thomas Hutchins first explored the Ohio valley and portions of the present Huntington Engineer District in the eighteenth century, he had the task of surveying and mapping the rivers for navigation and describing basin resources for the use of armies and pioneers moving into the Ohio valley frontier. Hydrographic surveying and mapping and basin resource studies were still an important element of the work of the Huntington Engineers in 1976.

Captain Henry M. Shreve, Colonel Stephen H. Long, and Captain John Sanders had begun the improvement of Ohio River navigation in the early nineteenth century, and Colonel William E. Merrill and General William P. Craighill had extended navigation improvements to tributaries and developed plans for slackwater navigation in the late nineteenth century. The improvement of waterways navigation in the Ohio valley was still a key function of the Huntington District in 1976.

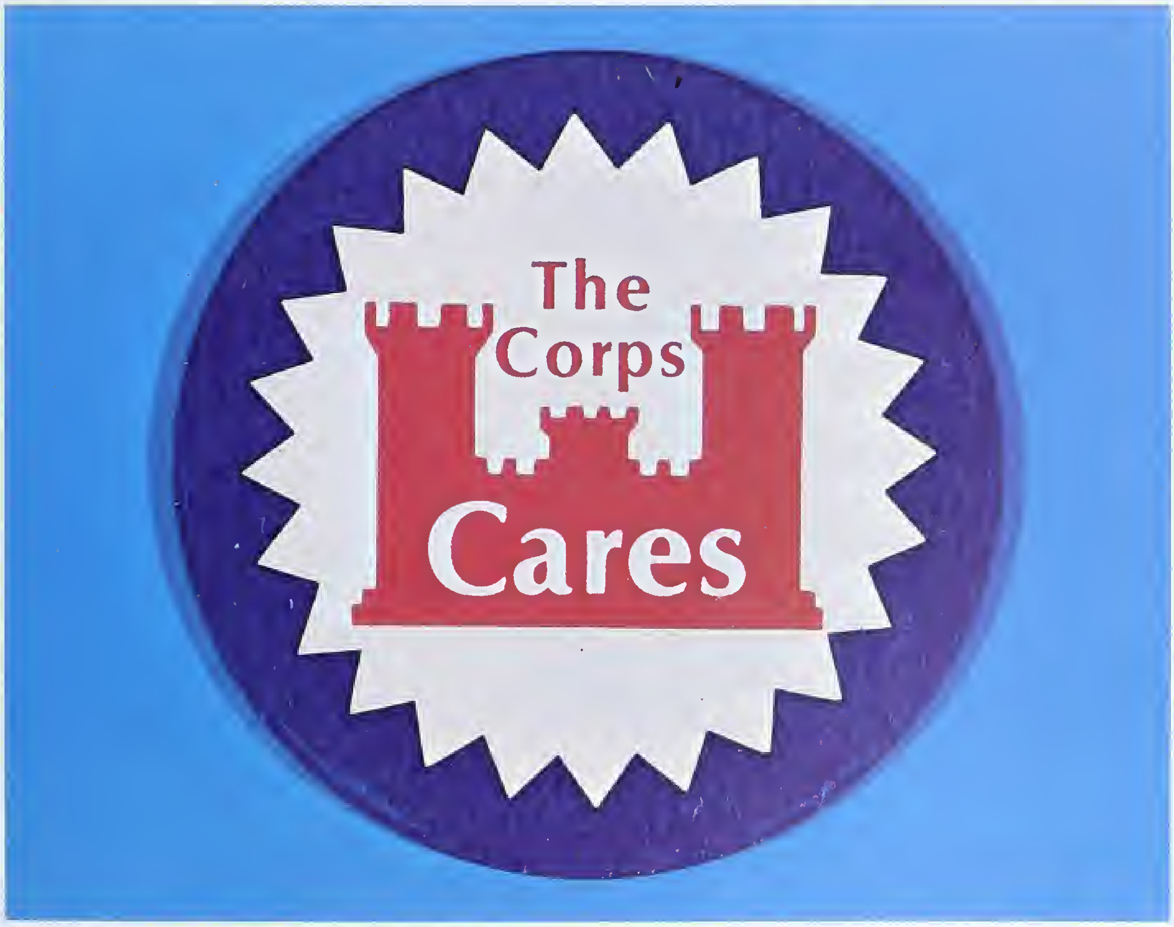
The flood control mission assigned to the Corps of Engineers and the Huntington District in 1936 had grown and expanded to include provisions for public recreation, water supply, water quality, fish and wildlife enhancement, and other related purposes. And from time to time the District performed emergency military construction, disaster recovery work, Civil Defense support activities, post office construction, and other special missions. These undertakings continued the historic role of the Engineers, who had always been America's primary engineering-construction agency, surveying and mapping the frontiers, building roads, railroads, and waterways, erecting national monuments like the Washington Monument and the Lincoln Memorial in Washington, digging the Panama Canal, building for flood control, paving airfields, building missile bases and space age installations, and, in short, performing whatever difficult technological tasks they were assigned.

On Engineer Day, 16 June 1972, the anniversary of the founding of the Corps of Engineers in 1775, General Frederick J. Clarke, Chief of Engineers, emphatically asserted:

> We are going to be doing the Nation's water resource and National defense engineering and construction business for a long time to come. Even our critics will grudgingly admit and recognize that we do have a tremendous amount of competence, and a great deal of integrity.

The multifaceted work of the Corps of Engineers would continue, General Clarke proclaimed, because: "The Corps Cares."

The men and women of the Huntington District did indeed care. They took great pride in the accomplishments of the District and in the achievements of the Army Engineers who had been at work in the Ohio valley since early settlement. The Huntington Engineers were confident in 1976 that, whatever the crises of the future might be, they could respond to the challenge, accomplish the task, with dedication and verve equaling their predecessors.



Huntington Federal Building, home of the Huntington District, Corps of Engineers.

Chronology of Command

DISTRICT ENGINEERS: HUNTINGTON DISTRICT, 1922–1977

Major Malcolm Elliott	1 July 1922–14 August 1922
Major Milo P. Fox	14 August 1922–19 April 1923
Major William P. Stokey	19 April 1923–30 June 1923
Major Harry M. Trippe	30 June 1923–24 May 1927
Major E. D. Ardery	24 May 1927–13 October 1930
Major Fred W. Herman	13 October 1930–31 July 1934
Major John F. Conklin	31 July 1934–14 June 1937
Lt. Col. J. D. Arthur, Jr.	14 June 1937–29 September 1940
Lt. Col. F. H. Falkner	29 September 1940–21 July 1942
Col. Wilson B. Higgins	21 July 1942–24 May 1943
Lt. Col. Harry Pockras	24 May 1943–26 January 1946
Col. B. B. Talley	26 January 1946–18 March 1946
Lt. Col. John R. Sharp	18 March 1946–18 April 1946
Col. F. W. Gano	18 April 1946–3 December 1946
Col. A. M. Neilson	3 December 1946–1 October 1949
Col. D. T. Johnson	1 October 1949–20 July 1950
Col. Walter Krueger, Jr.	20 July 1950–16 March 1952
Col. E. R. O'Brien	16 March 1952–2 June 1952
Col. J. O. Colonna	2 June 1952–22 June 1953
Col. George T. Derby	22 June 1953–30 April 1956
Col. Herrol J. Skidmore	30 April 1956–29 August 1959
Col. Steven Malevich	29 August 1959–5 August 1962
Col. Harrington W. Cochran	5 August 1962–17 July 1965
Col. William D. Falck	17 July 1965–14 July 1968
Col. Maurice D. Roush	14 July 1968–29 June 1971
Col. Kenneth E. McIntyre	31 August 1971–19 July 1974
Col. Scott B. Smith	29 July 1974–31 January 1977
Col. George A. Bicher	26 April 1977–

DISTRICT ENGINEERS: SECOND CINCINNATI DISTRICT, 1880–1922

Capt. James W. Cuyler	1880–1883
Capt. James C. Post	1883–1887
Col. William E. Merrill	1887–1888
Capt. Daniel W. Lockwood	1888–1895
Maj. James F. Gregory	1895–1897
Maj. William H. Bixby	1897–1899
Capt. Harry F. Hodges	1899–1901
Maj. Ernest H. Ruffner	1901–1905
Maj. James G. Warren	1905–1909
Maj. John C. Oakes	1909–1912
Maj. Lewis H. Rand	1912–1913
Lt. Col. Henry Jervey	1913–1915
Maj. Robert R. Ralston	1915–1916
Maj. William P. Stokey	1916–1917
Mr. Benjamin F. Thomas	1917–1918
Maj. William P. Stokey	1918–1922

DISTRICT ENGINEERS, WHEELING ENGINEER DISTRICT, 1901–1922

Capt. William E. Craighill	1901–1902
Maj. George A. Zinn	1902–1906
Capt. Frederick C. Boggs	1906–1907
Capt. Frederick W. Altstaetter	1907–1913
Maj. James P. Jervey	1913–1914
Maj. Thomas H. Jackson	1914–1916
Lt. Col. Horton W. Stickle	1916–1918
Col. George P. Howell	1918–1919
Lt. Col. Curtis W. Otwell	1919–1920
Maj. Malcolm Elliott	1920–1922

DISTRICT ENGINEERS, FIRST CINCINNATI DISTRICT, 1871–1946

Col. William E. Merrill	1871–1891
Maj. D. W. Lockwood	1891–1892
Maj. Amos Stickney	1892–1896
Maj. W. H. Heuer	1896–1897
Maj. William H. Bixby	1897–1902
Col. Garrett J. Lydecker	1902–1904
Col. Ernest H. Ruffner	1904–1906
Maj. James G. Warren	1906–1906
Col. William T. Rossell	1906–1909
Col. James G. Warren	1909–1910
Maj. John C. Oakes	1910–1910
Col. Henry Jervey	1910–1915
Maj. George R. Spalding	1915–1916
Maj. Robert R. Ralston	1916–1917
Col. Lansing H. Beach	1917–1917
Mr. Robert R. Jones	1917–1919
Col. Earl I. Brown	1919–1921
Lt. Col. E. N. Johnston	1921–1923
Maj. A. K. B. Lyman	1923–1926
Lt. Col. Roger G. Powell	1926–1931
Capt. James D. Cleary	1931–1932
Lt. Col. Charles L. Hall	1932–1936
Lt. Col. Dabney O. Elliott	1936–1939
Maj. Fred T. Bass	1939–1942
Col. B. F. Vandervoort	1942–1942
Lt. Col. Joseph E. Gill	1942–1942
Lt. Col. J. H. Veal	1942–1943
Lt. Col. Ralph J. Griffin	1943–1944
Lt. Col. F. A. Muhlenberg	1944–1945
Col. Paschal N. Strong	1945–1946
Lt. Col. George N. Kibler	1946–1946
Col. A. M. Neilson	1946–1946

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Chapter IX: A Back Door Approach To Flood Control

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Chapter X: Reaching The Front Door To Flood Control

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Chapter XII: The Riverine Revolution

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Chapter XIII: Flood Control South of the Ohio

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The "308 Report" on the Kanawha River basin is U.S., Congress, House, *Kanawha River*, H. Doc. No. 91, 74 Cong., 1 Sess., 1935. The history of Kanawha basin projects is outlined in the *Annual Reports of the Chief of Engineers*. For the Sutton project, see Huntington District, *Castle Comments*, November 1956; Sutton Dam Dedication Committee, *Sutton Dam Dedication* (July 1961); and "Remarks by Lieutenant General W.K. Wilson, Jr., at Dedication of Sutton Reservoir" (copy in Huntington District Public Affairs Office). For Summersville project, see Huntington District, *Summersville Dam & Reservoir, Gauley River, West Virginia* (Huntington, 1964); Huntington District, "After Action Report: Dedication of Summersville Dam and Reservoir by Lyndon Baines Johnson" (report in Huntington District Public Affairs Office, 1966); and Huntington District, *Information Bulletin*, July 1964, March 1967, April 1967, and June 1967. General Starnes' description of the Swiss project is printed in U.S., Congress, House, Committee on Appropriations, *Public Works Appropriations for 1972*, 92 Cong., 1 Sess., 1971, pp. 8-10.

Chapter XIV: Flood Control North Of The Ohio

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